

BLITZKRIEG!

POPULAR MECHANICS MAG



WRITTEN SO

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SEE PAGE 210





"DON'T TELL ME ABOUT WIRING!" barks Mr. Johnson

"I do all my own wiring around the house, and I know that actual 'shorts' are the only things to worry about. As long as there's insulation on wire, everything's OK."

"That may be true in a house," says Fred, "but car wiring is different. Every cable's got to be built to carry a particular load and to meet particular conditions. If a cable is undersize, poorly constructed, or has corroded connections, it 'chokes off' the 'juice'—and the electrical system goes haywire."



"I suppose you're telling me I should replace every wire in this car!" grins Mr. Johnson. "Not at all," says Fred. "This is a Certified Re-Wiring station, and our check-up will spot electrical 'bottle-necks' anywhere in the system. Where we *do* find a defective cable, we replace with Packard cable—best there is."

FOR BETTER PERFORMANCE . . . SAFER HEADLIGHTS . . . GET A CERTIFIED RE-WIRING CHECK-UP TODAY

For more pep, power and economy from your motor—more light from your headlights—drive into a Packard Certified Re-Wiring station today. Let a trained mechanic check your electrical system with

accurate instruments . . . clean dirty connections and replace "bottle-neck" wiring. Look for the blue-and-gold Packard Certified Re-Wiring sign—your assurance that the job will be done right.

DEALERS: Ask your Packard jobber to arrange a showing of the new Packard Certified Re-Wiring film, "Copper Dollars," explaining the Certified Re-Wiring program. Packard Electric Division, General Motors Corporation, Warren, Ohio.

Packard
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TRADE MARK

THE STANDARD WIRING EQUIPMENT OF THE AUTOMOTIVE INDUSTRY



You may worry about the neighbor's kids

but here is one worry you can avoid

If those little rascals next door get your goat, there's not much you can do about it except change your address.

But you don't have to move to get Peace Of Mind about your chassis lubrication.

Let us Marfak your car every 1,000 miles, and be sure it is in perfect running condition.

For Marfak is Texaco's standardized 40-Point Lubrication Service. Every detail is checked. Nothing missed.

And at every vital friction point, a special lubricant goes on duty—a lubricant so tough it lasts twice as long as ordinary grease.

This lubricant is Marfak, from which the full service takes its name.

To keep your car in smooth-as-velvet condition, drive in and we'll do the rest.

TEXACO DEALERS INVITE YOU TO tune in the TEXACO STAR THEATRE—Starring Kenny Baker and Frances Langford—Every Wednesday Night—Columbia Network—9:00 E.D.T., 8:00 E.S.T., 8:00 C.D.T., 7:00 C.S.T., 6:00 M.S.T., 5:00 P.S.T.

Let us
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your car



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You kind of hope it is—for a lot of good news and good times come your way by telephone.

Maybe it's a date for Sister Sue. Or a golf call for Dad. Or Bill asking if Jimmie can go to the movies. Or Grandma calling Mother to find out if things are all right.

And everything is more likely to be all right when there's a telephone in the home. In many, many ways, it is a real friend of the family.

The Bell System cordially invites you to visit its exhibits at the New York World's Fair and the Golden Gate International Exposition, San Francisco.

BELL TELEPHONE SYSTEM



Popular Mechanics Magazine

H. H. WINDSOR, Founder

H. H. WINDSOR, Jr., Editor and Publisher

August, 1940

Vol. 74, No. 2

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50,000 Planes a Year

YANKEE ingenuity and talent for mass production, says Capt. E. V. Rickenbacker, should be able to turn out 50,000 planes a year by the end of 1942. But the first 50,000 will cost over \$6,000,000,000, and training pilots and mechanics is more difficult than manufacturing planes. Ten thousand planes for the Navy alone would require 20,000 pilots and 300,000 mechanics, and it wouldn't be smart to build planes that would be obsolete before pilots were trained to fly them. Read Capt. Rickenbacker's analysis of the air defense situation in the September issue.

\$2,500 Home for Eight

THEY call it a magic house and in many ways it is. Its cost is only \$2,500, plus the land. It was built in two days, has five rooms, living quarters for a family of eight. No prairie shack, it is a modern machine for living, efficient, economical, comfortable, designed after years of research by a philanthropic foundation. A September article tells of this new American home.

Next Month

BARNSTORMING pilots of the new generation are the fliers who go up at dawn and dusk to hop over trees and duck under power lines to sow crops from the air or dust them with insect poison. It's risky work and takes superb flying. One pilot lost part of his fuselage and tail when the cloud of sulphur blew up behind him but he got down all right. Those fellows know how to fly. They have to. Read about them in the September story, "Farming Takes to the Air."

Big Biscuit Cutter

SANDHOGS are mining blue clay between the toes of Chicago skyscrapers with big "biscuit cutters," giant rings of steel that exert a 4,800-ton push into the muck and squeeze it out like toothpaste. They're burrowing under the river with only a few feet of mud separating them from tons of water. Theirs is the business of boring Chicago's first passenger subway, a \$46,000,000 project. An article next month takes you down in the diggings.

Army on the Wing

NINE months of training at the army air schools prove to be just "grade school" when the graduate moves on to an air base. There, learning to "fly, bomb and shoot" in 300-mile-an-hour fighters and four-engined bombers, he finds college never ends. The September Coloroto section, with eight pages of color photographs, puts you in the school that's really high.

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"PYROIL was a great help in my fuel to win First Place in this year's Indianapolis 500 Mile Auto Race"

Wilbur Shaw



WILBUR SHAW—daring and dashing three-time winner of the annual 500 Mile Memorial Day Auto Classic at Indianapolis. Shaw won this hazardous, punishing, 117 mile-an-hour speed event in 1937, 1939 and again this year, 1940.

8 of the PRIZE WINNERS Use PYROIL

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TED HORN, 4th
JOE THORNE, 5th

BOB SWANSON, 6th
FRANK WEARNE, 7th
MEL HANSEN, 8th
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Again the great 500 mile Memorial Day automobile race at Indianapolis has been run. And again as in many years past, Pyroil has been a favored product of the winners.

The fact that Pyroil has been proved time and again on many speedways by the foremost of auto racing pilots, tells you that it must be a good product for your car. Ask your garage or service station salesman to tell you all about Pyroil, today. Or mail coupon, below. Manufactured and Guaranteed by Pyroil Company, W. V. Kidder, Founder, 58 Pyroil Bldg., Main St., LaCrosse, Wisconsin, U. S. A.



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TEST YOUR B.K.*



IN THIS BATTERY QUIZ

*BATTERY KNOWLEDGE

QUESTION: What are the three major functions of a storage battery in a car?

ANSWER: (1) To provide a source of current for starting and ignition; (2) to control the voltage of the electrical system; (3) to furnish current when the electrical demands exceed the output of the generator.

QUESTION: Does a battery store up electricity?

ANSWER: No, a battery can store only chemical energy which is produced from the electrical energy of the generator and is caused by the reaction between the sulphuric acid in the electrolyte and the active materials in the plates.

QUESTION: How does the battery produce electrical energy?

ANSWER: The stored-up chemical energy of the plates produces electrical energy when the battery is discharged. This reaction produces lead sulphate and water, which reduces the concentration of acid in the electrolyte.

QUESTION: What is meant by "self-discharge"?

ANSWER: When a battery stands idle, it loses chemical energy. This is "self-discharge," and it is very dependent on temperature. It amounts to one point loss of capacity per day at 70° F., and to nearly three points per day at 100° F. The loss is negligible at 0° F. Therefore, batteries should be stored in a cool place.

QUESTION: In what ways is summer harder on a battery than winter is?

ANSWER: In hot weather evaporation is very high, and unless water is added regularly the electrolyte level will get so low that it does not cover the top of the plates. Another danger is excessive output of the generator. This is more serious in summer because a battery stores up chemical energy faster in hot weather than in cold, with the result that it is more likely to gas and overheat.

QUESTION: What are the dangers of an over-charged battery?

ANSWER: If the generator charging rate is not properly controlled, the generator output may become excessively high, resulting in unnecessary wearing out of the plates. It is, of course, obvious that too low a charging rate will result eventually in a discharged battery.

QUESTION: What make of battery is original equipment in 40 per cent of American cars?

ANSWER: Delco batteries are used as original equipment by the manufacturers of nearly half the cars sold in America. This expression of confidence by leading car manufacturers is based on the fact that Delco batteries have proved their dependability in millions of cars. When a new battery is needed, replace with a Delco—available for all makes of cars.

Delco-Remy

World's Largest Manufacturer of Automotive Electrical Equipment

SHE DIDN'T MARRY HIM FOR HIS MONEY



IT'S NOT HOW OLD you are, but how young you look that counts! If you'd like to smooth a couple of years off your chin and jowls, get yourself a Barbasol Face. Modern Barbasol is more than kind to your skin. Containing soothing, beneficial oils, it protects against razor irritation while you shave—and leaves your face feeling soft as satin, after you've shaved!

HEY, BROTHER! If you're trying to improve your appearance, we've got a better idea. Try shaving with Barbasol for ten days and see how much younger you look. It's 25¢, 50¢, and 75¢ at all drugstores. Barbasol Blades, 5 for 15¢.



For Modern Shaving
No Brush • No Lather • No Rub-in

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HOW SAFE IS



YOUR JOB?

CAN YOU CLASS YOURSELF AMONG THE "OK-MUST KEEP!" EMPLOYEES?

NO USE dodging facts!

At times—in every company's history—the pay-roll goes onto the operating table for major surgery.

And when such times come, certain employees are amputated—sometimes a few, sometimes many.

Yet a certain few are always marked "OK-Must Keep!" And the many who are let out envy them—call them "lucky."

What's Behind Job-Holding "Luck"?

It can be *proved*, however, that there's almost always something more than luck involved.

Even the fellow who seems to "have a drag" may actually have a lot more on the ball than is apparent to his fellow workers.

He may have hidden values that only his superiors see or know about.

After all, the "I-Gotta-Drag-Club" has taken a bad licking. In fact, it rather completely disbanded in 1932-1933.

Yet why is it that some employees hold their jobs at the very time when others of seemingly *equal* ability lose theirs?

If it's not luck, there *must* be some explanation.

And there is one!

How to Insure Your Job

The secret of holding your job in hard times is to be invaluable to your employer. And a man or woman who is invaluable is usually a well-trained one.

Training is of many kinds—stems from many sources. But the LaSalle kind has been unusually successful. Nearly a million members, in a score of subjects, over a thirty year period can testify to that—and many can prove it by their pay envelopes!

They have cause to agree with us that the real secret of both promotion and job security is just this: "On your present job, make sure you are doing it well, then *train* for the job ahead!"

Why It Works

Put yourself at your own president's desk for a moment.

You are faced with cutting the pay-roll. First of all, you certainly are going to do your best to hold on to those employees who really know their present jobs.

But among them—the very last to go will be those

few who are also wholly or partly trained for the job ahead—even for the job *ahead* of the job ahead!

What You Should Do About It—

But true as these facts are, you probably will tend to do nothing about them.

"My job is safe," you think. "My company won't cut down—and even if it does, *I* won't suffer."

But doesn't the very fact that you have read this far indicate that there's some small doubt—a trifle of uneasiness in your mind?

Wouldn't you be more comfortable if right now *your* boss knew that *you* were taking LaSalle training—a piece of knowledge that upon request we take pains to bring to the personal attention of every LaSalle enrollee's superior?

What you *should* do about it is, therefore, as obvious as the coupon below.

—If You've Got What It Takes!

That coupon, you know, has helped increase the pay envelopes, brighten the lives, and secure the future for many men and women who saw what they *should* do —**AND THEN DID IT!**

It isn't easy. It will cost you hours of serious study, of leisure with friends, your radio, and the movies. And, even on our very liberal payment plan, it will also cost you some money.

But any worthwhile insurance does cost money. And since this is the nearest thing to job-certainty that we know about—it is *worth* money!

Why not at least investigate? *That* costs not a cent! The coupon will bring a quick response—may help start you on the way toward the future that's *due* you!

Better mail it now—and play safe!

FREE! Any of these booklets — or similar ones on your own field.



LASALLE EXTENSION UNIVERSITY

A CORRESPONDENCE INSTITUTION

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I'd like to know what you can do to help me better my job. Send me your free booklet and full details about the training I have checked below:

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☐ Traffic Management

☐ Modern Salesmanship

☐ Law: LL.B. Degree

☐ Executive Management

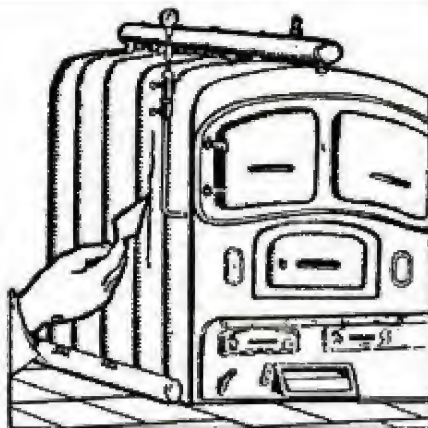
☐ Industrial Management

Name _____ Age _____

Address _____ Present Position _____

How to save money on home repairs

Sealing a crack in a heating boiler—one of the hundreds of economical home repairs that can be made with Smooth-On No. 1.



Leaks, and loose appliances—the bane of every household—need not be tolerated or expensively corrected when you have a can of SMOOTH-ON No. 1 on hand.

This many-purpose iron cement quickly remedies such nuisances and possible dangers at a cost of a few pennies for each application.

A can of SMOOTH-ON is as essential to a householder or shop as a hammer or screw driver. Once you have tried it and found how easily it can be applied, how positively it works, and how many jobs it can be used for, you will join the huge army of SMOOTH-ON boosters.

The free Smooth-On Handbook gives simple instructions with diagrams for ingenious, practical, money-saving repairs to mechanical equipment around the home and on the motor car and boat. Every householder and mechanic should have a copy of this useful manual.

Get Smooth-On No. 1 in 1¼-oz., 7-oz., 1-lb. or 5-lb. can from your hardware store, or if necessary, from us. For your protection, insist on Smooth-On, used since 1895.

FREE The Smooth-On Handbook — 40 pages — 170 diagrams—sent free if you return the coupon.

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Do it with **SMOOTH-ON**

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IMPORTANT NOTICE

It is the intention of this magazine to provide its readers with information regarding the latest developments in the mechanical arts. We take no responsibility as to whether the disclosures contained in our articles are covered by patents and advise readers to investigate this subject before making, using, or selling any of the products, machines, or processes described, in order to avoid possible liability for patent infringement.



"THE RUDDER'S GONE, SIR!"

● Fateful moment — when a ship loses its rudder! Then a great hulk drifts helplessly — and unless aid comes, that ship goes "on the rocks."

There are *men* who drift all their lives. Is it surprising that these rudderless souls end up "on the rocks"?

I. C. S. students are men who fashion their own "rudders" — out of common sense, determination, and *sound, essential training!* If you want to come into the Port of Prosperity and Security, then *you* must get the training you need. Get it "the I. C. S. way" — from textbooks that have been adopted by 25 State Universities — through methods that are *individualized* to fit your own *personal* requirements. Send the coupon — *today* — for complete information.

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Without cost or obligation, please send me a copy of your booklet, "Who Wins and Why," and full particulars about the course *before* which I have marked X:



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| <input type="checkbox"/> Aviation | <input type="checkbox"/> Boilermaking | <input type="checkbox"/> Heat Treatment of Metals | <input type="checkbox"/> Pharmacy | <input type="checkbox"/> Structural Drafting | |
| <input type="checkbox"/> Bridge Engineering | | <input type="checkbox"/> Highway Engineering | <input type="checkbox"/> Plumbing | <input type="checkbox"/> Structural Engineering | |
| <input type="checkbox"/> Building Estimating | | <input type="checkbox"/> House Planning | <input type="checkbox"/> Poultry Farming | <input type="checkbox"/> Surveying and Mapping | |
| <input type="checkbox"/> Chemistry | | <input type="checkbox"/> Locomotive Engineer | <input type="checkbox"/> Practical Telephony | <input type="checkbox"/> Telegraph Engineering | |
| <input type="checkbox"/> Civil Engineering | | <input type="checkbox"/> Machinist | <input type="checkbox"/> Public Works Engineering | <input type="checkbox"/> Textile Designing | |
| <input type="checkbox"/> Coal Mining | | <input type="checkbox"/> Management of Inventions | <input type="checkbox"/> Radio, General | <input type="checkbox"/> Toolmaking | |
| <input type="checkbox"/> Concrete Engineering | | <input type="checkbox"/> Managing Men at Work | <input type="checkbox"/> Radio Operating | <input type="checkbox"/> Welding, Electric and Gas | |
| <input type="checkbox"/> Contracting and Building | | <input type="checkbox"/> Manufacture of Pulp Paper | <input type="checkbox"/> Radio Servicing | <input type="checkbox"/> Woolen Manufacturing | |
| | | | <input type="checkbox"/> R. R. Section Foreman | | |

BUSINESS COURSES

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|--|--------------------------------------|--|---|---|--------------------------------------|
| <input type="checkbox"/> Accounting | <input type="checkbox"/> Advertising | <input type="checkbox"/> Civil Service | <input type="checkbox"/> First Year College | <input type="checkbox"/> Railway Postal Clerk | |
| <input type="checkbox"/> Bookkeeping | | <input type="checkbox"/> College Preparatory | <input type="checkbox"/> Foremanship | <input type="checkbox"/> Salesmanship | <input type="checkbox"/> Secretarial |
| <input type="checkbox"/> Business Correspondence | | <input type="checkbox"/> Commercial | <input type="checkbox"/> French | <input type="checkbox"/> Service Station Salesmanship | |
| <input type="checkbox"/> Business Management | | <input type="checkbox"/> Cost Accounting | <input type="checkbox"/> Grade School | <input type="checkbox"/> Sign Lettering | <input type="checkbox"/> Spanish |
| <input type="checkbox"/> Cartooning | | <input type="checkbox"/> C. P. Accounting | <input type="checkbox"/> High School | <input type="checkbox"/> Traffic Management | |
| | | | <input type="checkbox"/> Illustrating | | |
| | | | <input type="checkbox"/> Lettering Show Cards | | |

DOMESTIC SCIENCE COURSES

- | | | |
|---|---|---|
| <input type="checkbox"/> Advanced Dressmaking | <input type="checkbox"/> Home Dressmaking | <input type="checkbox"/> Tea Room and Cafeteria |
| <input type="checkbox"/> Foods and Cookery | <input type="checkbox"/> Professional Dressmaking and Designing | <input type="checkbox"/> Management, Catering |

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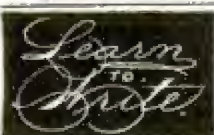
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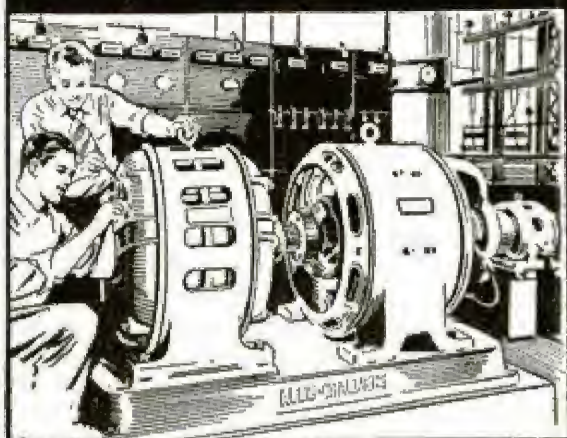
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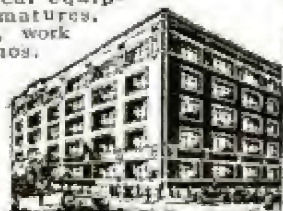
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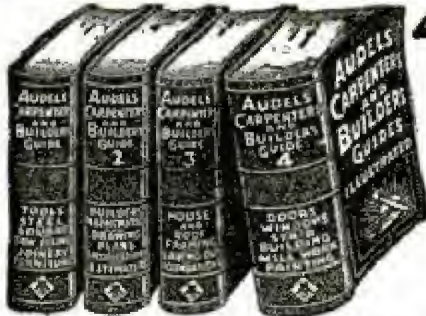
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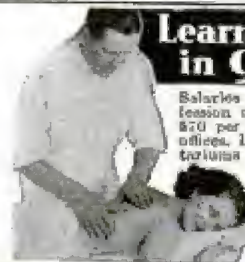
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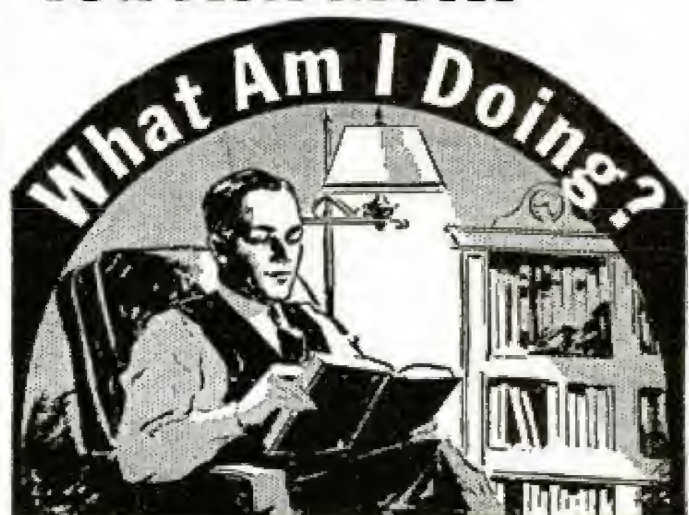
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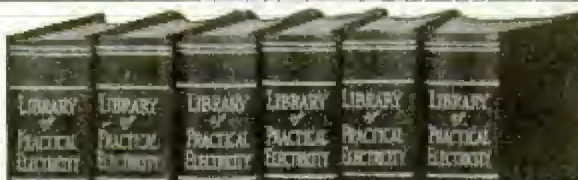
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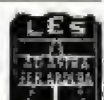
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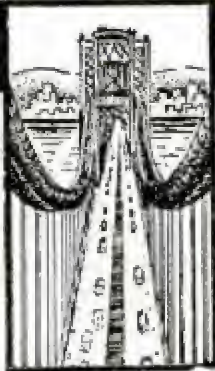
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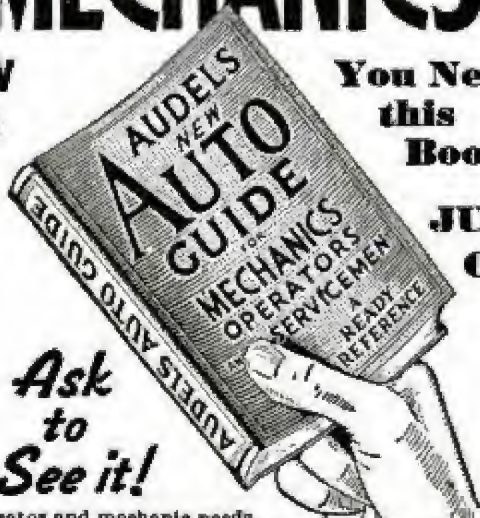
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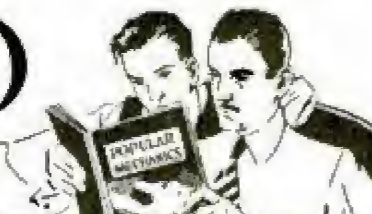
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BUILD Your own machine tools. Castings and blue prints at nominal cost. Send 10c for 2 color 28 page catalog, 34 prints covering 12 metal-working projects, \$1.50. 23 prints covering 6 wood-working projects, \$1.00. Lewis Machine Tool Co., Dept. M-8, 1000 Alhambra Ave., Los Angeles.

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WE Pay cash for precision machine tools, gauges, micrometers, instruments. Arcade Electric, Freeport, N. Y.

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ROLL Developed 6 or 8 prints including 5x7 enlargement 25c coin, without enlargement 20c coins. Gem Photo Service, 3355 West 63rd, Chicago, Illinois.

FILMS Developed and enlarged, sizes 127, 130, 620, 116 and 616. 8 exposure rolls developed and enlarged to post card size, 25c; 12 exposure rolls, 35c; 16 exposure rolls, 45c. Same-day service. Knickerbocker Photo Service, General P.O. Box 546L, New York City, N. Y.

CASH Weekly. You do not have to be a professional, any simple picture may be a winner. During the campaign cash prizes awarded for best pictures submitted. Weekly prizes: First \$5.00; second \$3.00; third \$2.00. Requirements are that your pictures must be finished in our studio. The judges' decisions shall be final. In case of the duplicate prizes awarded. Send in as many rolls of film as you choose. Any six or eight exposure roll developed and printed for 25c. Free enlargement coupon with all roll orders. Notice the quality of our work. The winners of the previous week furnished all entrants upon request. Empire Photo Finishers, Box 297, Dept. P, Oedensburg, New York.

HIGHEST Class photo finishing. We use fine grain developer. Any size roll developed and printed and two enlargements 25c. One dozen reprints and two enlargements 36c. Try us once. Helen Art Photo Service, Albany, New York.

FREE Beautiful album with cellophane envelopes plus roll developed and two sets prints, 25c. Free mailers. Same-day service. Pho-T-Pho, Box 24-F5, Highland Park, Mich.

ROLL Developed and eight glossy prints 25c; dull finish 30c. Properly washed, permanent. Wayland Photo Service, Box K-2, Wayland, New York.

FREE! Best snapshot on attractive photo button with 16 prints each roll 25c. Beautiful novelty premiums. Novel-Ad Co., BM-3327 North Ave., Chicago.

PHOTOGRAPHY For pleasure and profit. Prepare for profitable business or fascinating hobby at home. Common school education sufficient. Write for information and requirements. American School of Photography, 3601 Michigan Avenue, Dept. 3454, Chicago.

24 PRINTS From roll, enlargement coupon, photograph wild duck scene. Half dollar. Fotocraft, Stuttgart, Ark.

A PROFESSIONAL 4x6 enlargement of each exposure. Eight exposure rolls. Coin 25c. Hi-Tone, Box 2426, E. Cleveland, O.

5x7 ENLARGEMENTS 10c From your negative. Rolls developed 20c. Catlin Films, Catlin, Ill.

ROLL Developed and printed, two enlargements, one in color, all for 25c coin. Photo Finisher, Station E, Box 42K, Columbus, Ohio.

ANY Photo, negative enlarged to life-like 5x7—15c. Quick service. Rolls developed and 8 prints plus one colored 5x7—25c. Promenade Photos, 30 East 20th, New York.

ROLL Developed, 8 lifetime prints, 5x7 enlargement 25c. V & R Photofinishing, Devon, Conn.

20 VELOX Reprints 25c; 100—\$1.00. Roll developed, 16 Velox prints and 2 professional enlargements 25c. Same-day service. Superior Finishers, Monroe, Wis.

LIFE Photo finishing lasts a life time. Film developed, 16 prints, 2 enlargements 25c. 20 prints 25c. Life Photos, Hutchinson, Kansas.

ONE Print and one free 4x6 enlargement of each of all six or eight negatives on a roll, 25c. Jumbo Laboratories, Box 426, Lincoln, Nebraska.

FREE—To Popular Mechanics readers: Any roll developed, 16 sparkling Nu-Art neverfade enameled prints plus two beautiful Hollywood enlargements and two free Leathertone frames only 25c. Overnight service. Lifetone Studios, F-39, Des Moines, Iowa.

CANDID Developing trial—36 exposures enlarged 3x4, including free enlargement coupon—65c. Micrograin Laboratories, N-39, Des Moines, Iowa.

35MM. Rolls fine grain developed, vaporated and enlarged, 3 1/4"x4 1/4" for \$1. Guaranteed minimum 25. "Electric-eye" precision. Deckled prints. Embossed margin and date. Free mailers. 8 exposure rolls beautifully finished in free album, 25c. Satisfaction guaranteed or money back. Mailbag Film Service, Box 5444 A, Chicago.

SNAPSHOTS, Roll finished (16 pictures 25c). Speedy Service, Box 64, Wilkes-Barre, Penna.

ROLL Developed and 8 lustrous, natural finish, permanent Velox glossy prints 25c—reprints 3c each. Fotoprint Service, Box I, Roanoke, Virginia.

FREE Trial—16 sparkling lifetime prints, three lovely Hollywood enlargements and free Leathertone frame with roll—25c. Overnight service. Nu-Art Studios, L-39, Des Moines, Iowa.

ROLL Developed and 8 beautiful enlargements 2 to 6 times larger—high gloss—deckled edge. Any 8 exposure roll 25c coin. Reprint enlargements 3c each. Alden Photos, 258-B Aster Sta., Boston, Mass.

OIL Coloring photographs a fascinating hobby or profitable business. Learn at home by easy simplified method. Previous experience unnecessary. Send for free information and requirements. National Art School, 3601 Michigan Avenue, Dept. 343B, Chicago.

TWO Beautiful professional double weight enlargements, eight lifetime prints, 25c. Prompt—careful. Film mailers free. May's Photo Shop, Box 870-AL, LaCrosse, Wis.

CLIK-TIK Is sensational. 25c brings 16 prints. Reprints 2c. Clik-Tik, Sioux Falls, S. Dak.

ROLL Developed, eight beautiful professional 4x6 gloss enlargements; 25c. Crystal Studios, Box 159-F, Rushford, Minn.

ENLARGED—Film developed and 8 double size prints 25c. Free mailers. Economy Lab, Box 286, Olean, N. Y.

YOUR Choice! Roll developed, 8 permanent prints and 1 5x7 hand painted enlargement or 2 5x7 unpainted enlargements, 25c. Prompt service. Individual attention to each picture! Janesville Film Service, Room 454, Janesville, Wisconsin.

ENLARGEMENTS On beautiful portrait paper—Four 8x10 \$1.00. Six 5x7 \$1.00. Ten 4x6 \$1.00. Miniservice, Dept. PMS7, Box 318, General P.O., New York.

PROFESSIONAL. Overnight, eight prints, two enlargements, 25c. Fotoservice, 1942-D Mariow, Toledo, Ohio.

FOUR Beautiful 5x7 enlargements, two sets guaranteed fadeproof glossy prints with your roll film developed only 25c. Trial offer. Reprints 16 for 25c. ARO Studios, Dept. 12, Des Moines, Iowa.

ROLL Developed—Beautiful enlargement and 16 neverfade prints, 25c. Reprints, 3c. Finest quality. Fastest service guaranteed. Dick's Photo, B-1A, Louisville, Ky.

ROLL Developed, 16 artistic deckled edged permanent prints, 25c. Reprints, 3c each. 100 reprints, \$1.50. "As reliable as Uncle Sam's mail!" Midwest Photo, Room 554, Janesville, Wisconsin.

PROMPT Service—Quality work; 2 beautiful doubleweight gloss enlargements, 8 guaranteed neverfade prints each roll 25c. Excel Photos, Dubuque, Iowa.

YOU Get one 5"x7" silk enlargement. Send negative—10c—P.D.Q., Elmhurst, Ill.

FREE Snapshot magazine, mailing equipment and price list. H.F.H. Co., Jamaica Plain, Mass.

ROLL Filmachine developed and your choice (1) 8 Finerfotos and 2 professional bromide enlargements; or (2) 16 guaranteed Finerfotos or (3) 8 Finerfotos and one beautiful oil colored enlargement, 25c. Order by number. Prompt service. Finerfotos, Box D-898, Minneapolis, Minn.

MILLIONS Now know "Hollyprints Means Better Prints." Two enlargements, eight prints with trial roll developed—25c. Framed enlargement coupon free. Hollyprints, F-1350 Hollywood, California.

PROMPT Service. Guaranteed work. Two beautiful portrait type doubleweight enlargements, eight neverfade gloss prints, each roll 25c. Dubuque Film Service, Dubuque, Iowa.

ROLL Developed, 16 Velox prints 25c or 8 prints and 2 enlargements. Rapid, Villa Park, Illinois.

THE Modern Finishers, St. Paul, Minn., are the outstanding finishers in America for low prices, fast service, guaranteed neverfade pictures. Roll developed 8 Modernone prints 20c. Roll developed, 16 Modernone prints 25c. Reprints 2c each. 16 for 25c. Coupons on enlargements, 35mm. 36 exposure roll developed fine grain, 1 each enlarged \$1.00.

35MM. Fine-grain developed, 36 big 3 1/4"x5 enlargements \$1.00. Cartridge reloaded 35c. Photoshop, Linton, Indiana.

FINER Finishing specials 25c. 6—8 exposure rolls developed, your choice—16 prints or 8 prints with 2 professional enlargements or 8 prints and one colored enlargement. Genuine nationally known Moentone superior quality. Moen Photo Service, 431 Moen Bldg., La Crosse, Wis.

CANDID Special. 35mm. rolls enlarged to 3 1/4"x4 1/4", \$1.00. 18mm. rolls 60c. 3 1/4"x4 1/4" reprints 3c. Brown Photo Company, 1910-61 Emerson, Minneapolis, Minn.

IMMEDIATE Service! Better pictures. Sixteen guaranteed prints from roll, 25c. One colored or two plain enlargements and 8 guaranteed prints, 25c coin. Special Coupon for 8x10 enlargement given with every 25c worth Kodak finishing. Any 36 exposure, 35 mm. film fine-grain developed and each good negative enlarged to 3x4 prints for only \$1.00. 3x4 reprints, 4c each. One day service. Details and mailers free on request. American Studios, Box 22, LaCrosse, Wis.

ROLL Developed, 8 brilliant fadeproof Velox prints and two professional enlargements 25c. Overnight service. Young Photo Service, 405-C, Albany, N. Y.

ONE 6 1/2"x8 1/4" Plate sunk enlargement or one 5x7 hand colored enlargement with each roll developed and 8 prints 25c. 36 exposure roll developed and 36—3 1/4"x4 1/4" enlargements \$1.35. 18 exposure roll 75c. Vidor, 321-P Hennepin, Minneapolis, Minn.

BEAUTIFUL Enlargement from each picture on roll 25c. Cut Rate Photos, Dept. B-4, Janesville, Wis.

PROFESSIONAL Service, any 6 or 8 exposure roll, including two 5x7 enlargements 25c. Film Capital Service, Box 504, Rochester, N. Y.

ROLLS Developed, Two 5x7 and 8 prints, 25c. Reprints 2c. Photolab, 1806-CA Wabash, Chicago.

ROLL Developed, 16 Velox prints 25c. Dividend coupon, 16 Velox reprints 25c. Willard Studios, Box 3535-A, Cleveland, Ohio.

TWO Beautiful prints from each picture on roll 25c. Twenty years of satisfied customers. Quick service. Lens Photos, Dept. J-4, Janesville, Wis.

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PROMPT Service! Rolls developed, two Velox prints each negative 25c. Hensch Studios, Harrisburg, Penna.

18 LIFETIME Prints, 2 sparkling Hollywood enlargements each roll 25c. 21 reprints 25c; 100—\$1.00. Finished 3 hours. 25 other bargains. Overnight Studio, Albany, Wis.

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ROLLS Developed, two prints each and two free enlargement coupons, 25c; reprints, 2c each; 100 or more, 1c. Summers' Studio, Unionville, Mo.

THREE Prints each good negative in roll 25c. Reprints 3c. Fred D. Eastman, Bode, Iowa.

16 PRINTS With roll 25c. 16 reprints 25c. Rex Photo, Ogden, Utah.

FOR The discriminating amateur—Rolls developed 2 prints each, 25c. Reprints 3c. Superior workmanship. Same day service. Paramount Co., 327 E. 92nd St., New York.

ROLLS Developed, 16 guaranteed prints, 25c, reprints 2c. Photolab, 1806-C Wabash, Chicago.

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CAMERA Repairing. Bellows made to order, shutters repaired. Bellows made to fit all standard cameras! United Camera Co., Inc., A-1515 Belmont, Chicago.

CAMERAS And supplies. Free illustrated catalog listing everything photographic—still and movie cameras, films, lenses—at tremendous savings. Hundreds of bargains, new and used. All guaranteed. We take your old camera or equipment in trade. Write now for your free copy of our newest money-saving bargain book—just out! Limited edition. Hurry! Central Camera Co., (Photographic Headquarters since 1899) 230 S. Wabash, Dept. H-16Z, Chicago, Ill.

MAKE Money in photography. Learn quickly at home. Easy plan. Previous experience unnecessary. Common school education sufficient. Interesting booklet and requirements free. American School of Photography, 3601 Michigan Avenue, Dept. 3432, Chicago.

HIGH Allowance for your camera on Perflex, Graflex, Leica, etc. Enlargers cheaper. Graylee, Kennedy, Alabama.

AERIAL Cameras—How to make and use them. Complete 72-page book only \$1.00. Aircraft Directory, Athens, Ohio.

PHOTOGRAPHERS: Earn good money advertising. Quarter brings complete instructions. Satisfaction guaranteed. Photo-Ad, Box 864, Boise, Idaho.

ENLARGER \$1.59. Enlarges eight times size of small negatives. Fully guaranteed. Paramount Sales Company, 89 Dudley Street, Boston, Mass.

FREE Camera catalog PM5. Largest discounts. Cameras, movie equipment, binoculars. Trade-ins. Brenner, 943 Penna. Ave., Washington, D. C.

CANDID Midjet P4.5—\$9.00. Bargain lists free. Debski, 1554 East 17th, Brooklyn.

BASS Says: Shrewd buyers, write Bass. For 30 years headquarters for everything in photography. 72-page Bargaingram No. 242 is interesting and free. Write for your copy. Don't trade until you write Bass Camera Company, Dept. AQ, 179 West Madison St., Chicago, Ill.

HAVE You a camera? Send ten cents for recent number of our big magazine, showing how to make better pictures and earn money. American Photography, 116 Camera House, Boston, 17, Mass.

CAMERAS, Films, paper 25% to 35% discount. Paramount Photo Division, 327 East 92nd St., New York.

MOTION PICTURES AND SOUND EQUIPMENT

BASS Says: The new Revere double 8 camera at \$29.50 with F:3.5 lens is a honey. The new Revere projector at \$59.50 is great value. Both described in our new catalog No. 245, 72 pages. Write for it. New RCA Model PG-170 16mm. sound on film projector is ready. Greatest \$360.00 value. Literature on request. Write Cine Headquarters, Bass Camera Company, Dept. A, 179 West Madison St., Chicago, Ill.

USE Peerless "Plus + Violet" reversible movie films for better movies at less cost. Weston 12—daylight loading spools—free processing. Univex, 60c each, two rolls for \$1.00; 25 ft. double 8mm., \$1.00, four rolls for \$3.50; 100 ft. 16mm., \$2.35, four rolls for \$8.00. (Also bulk). Details free. Peerless, Box 1310P, Hollywood, California.

WRITE For new large two color 1940 catalogue nationally advertised movie cameras, projectors, films, accessories. Payments low as \$2.50 monthly. Don Elder's Home Movies, Dept. 18, 739 Boylston Street, Boston, Mass.

35 MILLIMETER Sound film and equipment to exchange for 16 millimeter sound film and equipment. Mertz, Virginia, Ill.

COMPLETE 16MM. silent library for sale. 50 features, 75 reels comedies, cartoons. \$5.00 per reel. Remington Pictures, Cincinnati.

SILENT 35MM. films. Lowest prices! Demsey, 1223 Berkley, Youngstown, Ohio.

8MM. AND 16MM. art films. Lists free. Catalog 10c. Box 108, Lefferts, Brooklyn, N. Y.

"LEMOINE Process" titles! Film catalog! Stamp. LeMoine Films, Nevada, Missouri.

MOVIE Shop special. 100 ft. 16mm. rapid outdoor film, including processing, \$1.95. Free lists. Movie Shop, 838 Broadway, Bayonne, N. J.

NEW Sateen screens. 9'x12' \$15.00. Pathe \$55.00 hand generator, special \$9.50. Drying drum complete for 1000' 16mm., 500' 35mm., \$27.00. Acme portable 35mm. projector, 1000', motor driven, complete \$25.00. Powers heads, also complete outfits, \$10.00 up. Universal camera, less lens. 2-400' internal magazines \$33.00. Victor "25" sof 16mm. projector, complete \$149.50. Odd 400' silent 16mm. films, \$1.95; sound film, \$2.95. Pathex 9 1/2mm. 18.00 camera, f:3.5, special \$2.99; film \$1.49 with processing. Trades accepted. bought. Mogul's, 64 West 48th, New York.

MOVIE Film processing outfit \$2.95. Roycraft, Box 1810, Milwaukee, Wis.

ART Sample, 10c; other kinds, lists free. Goodwill Company, Jackson, Tennessee.

OUTDOOR Film 100 ft. 16mm. \$1.95. 25 ft. double 8mm. 93c. Processing included. 8mm. camera, projector, screen \$10.00 complete. Free lists. Home Movies, Box 216, Easton, Penna.

EXOTIC Movies, sample, dime. Catalog 8-16mm. free. Cameras, projectors, \$6.00 up. Graylee, Kennedy, Alabama.

100 FEET 16mm. including processing now \$1.50. 8mm., 16mm. from 1c foot. Cameras and projectors, low priced, easy terms. Morrison's, Province St., Boston, Mass.

RENT 8-16MM. programs, 7 reels \$2. Free catalogue (with sample film 10c). Parkway Exchange, 1040 Eastern Parkway, Brooklyn.

SENSATIONAL 8-16MM. movies "Bombs Over Europe." Thousands other subjects. Sold-exchanged. Films rented everywhere. Bargains in equipment. Trades accepted. Free illustrated catalogue (with sample art 10c). Garden Film, 317 West 50th, New York.

SHOW Movies outdoors! 35mm. bargains. Calderara, 5119 South St. Louis, Chicago.

MOVIE Cameras, projectors, films, etc., bought—sold—exchanged. Lists free. Art samples 25c. Peerless, Box 1310-P, Hollywood, Calif.

GUARANTEED 8mm., 16mm., 24-hour reversal, processing, Eso-S, 3945 Central, Kansas City, Missouri.

ART Films, Sample, dime; catalog free. Cineart, 2443 Gunnison, Chicago.

MOVIE Film. Develop yourself. Univex, Eastman, etc. Chemical samples 15c. Raw film wholesale. Lake Camera Exchange, Gary, Ind.

15% TO 25% Discount on still or movie cameras. Free circular. Paramount Co., 327 E. 92nd St., New York City.

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RADIO Kits—\$3.95 up. Single band; all wave, 5-10 tubes. Save 50%. McGee Radio, EP-10, Kansas City, Mo.

RADIOS—\$3.95 Up. Save 50%. Wind-chargers, electric fences, power plants. Home agents wanted. Catalog free. Marco-E, Kansas City, Mo.

RADIO Engineering, broadcasting, aviation and police radio, servicing, marine and Morse telegraphy taught thoroughly. All expenses low. Catalog free. Dodge's Institute, Ames St., Valparaiso, Ind.

SEND For free giant money saving radio and phonograph record catalogue. United Radio Company, 1000-M, Newark, N. J.

HOME-BUILT Radio receivers that provide factory-built performance. Anyone can assemble and wire high-grade receivers from Meissner kits. Big 168-page instruction manual contains complete constructional information on 30 models, one to seventeen tubes. Includes television and frequency modulation receivers with latest data. Send 50c to Dept. PM-8, Meissner, Mt. Carmel, Illinois.

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SWISS Music box works—They operate by winding main spring. Make your novelties. Big market! Price according to size; \$1.35, \$1.70, \$2.10, \$3.90. Music Box Company, 147 West 46th Street, New York.

SONGS: Songpoems; bought, composed, published, recorded, radio broadcasted. Best offer. Free advice. Metro-Melody Music Publishing Company, San Francisco.

SPECIAL \$3.85 Postage prepaid piano tuning tools, with book of instructions. Hall Music Co., Waco, Texas.

MUSIC Arranged to poems. (Sample 10c). Frank Wildt, Lancaster, Penna.

STUDY Guitar, instrument free. Rodenius, 75th Ave. West, Duluth, Minn.

ADULT Beginners' piano course \$1.25. Moses, 315 West 86th, New York.

LEARN Swing piano! Postal brings free folder. Christensen, 751 Kimball Hall, Chicago.

ORIGINAL Song poems wanted. Free examination by professional music writers. Five Star Music Masters, 6 Beacon St., Boston.

PHONOGRAPH Records 10c. Catalogue. Paramount, AF-358 East Market, Wilkes-Barre, Pennsylvania.

TWENTY Late phonograph records, only \$1.00. (Shipping charges collect.) Paul, Oswego, Illinois.

FREE Book to songwriters—Original poems, songs wanted. Variety, Dept. V, Salem, Indiana.

MANUTYPE: A small instrument that prints music fast, neat, easy to read. Price \$2.00 postpaid. Manutype Company, Ft. Wayne, Indiana.

SONGWRITERS—Agents, new sales plan. National Music-D, 532 Sixteenth, Oakland, Calif.

SONGWRITERS! Words, melodies! Amazing offer. Hibbeler, C-5, 2157 N. Avers, Chicago.

WANTED: Original poems for musical setting. Publication, radio, recording service. Richard Brothers, 24 Woods Building, Chicago.

SONGWRITERS—Splendid proposition. Newark Song Publications, 1207 Carbon, Syracuse, N. Y.

MUSIC Printed. Fifty copies your song, "Stylestyle" artist prints, \$6.00. Sample sent. Orchestra, brass band, choral. Gil Friar, 401 Kambach, (II), Pittsburgh, Penna.

SONG Poems wanted. Free examination. McNeil, Master of Music, 510-PM South Alexandria, Los Angeles, Calif.

SONGWRITERS. Write for free inspiring booklet outlining new opportunities for amateur songwriters. Allied Music, Dept. 4, Box 507, Cincinnati, Ohio.

MUSIC Composed to words. Wonderful proposition. Bauer Bros., Oshkosh, Wis.

MUSIC Composed to words. Rhyming pamphlet on request. Phonograph recording of completed songs. Send poem for consideration. Keenan's Studios, Dept. PM, Box 2140, Bridgeport, Conn.

WRITE Songs. Big money and reputation. Write for information. J. Gordon Pub. Co., 201 N. Hoyne Ave., Chicago.

WANTED! Lyrics, melodies for songs. We arrange, publish, sell. Superior Song Studios, Passaic, N. J.

SONG Writers. Send for publishing agreement. McKinley Music Publishers, 1501 E. 55th St., Chicago.

BUSINESS OPPORTUNITIES

AMAZING Lawn mowers. Gasoline or electric power. Whirling rotary blades. \$50.00 and up. Distributors wanted. Rotary Mower Company, Omaha, Nebraska.

INCREASE Your earnings in a business of your own, with all the trade you can attend to. Become a Foot Correctionist and in a few weeks earn big income in service fees—not medical or chiropody. Easy terms for home training, no further capital needed, no goods to buy, no agency. Address: Spencer System, 533 Back Bay, Boston, Mass.

MONEY Can be made repairing scales. For information regarding instructions on repairing, send stamped envelope. Ackerman Scale Repairing Instructions (Copyright 1940), Box 1653, Charlotte, N. C.

START Home business making statuary, plaques, art goods, novelties, souvenirs, concrete pottery, garden furniture, artificial marble flooring, liquid marble. Make your own flexible molds. Amazing profits. Valuable folder free. Creative Publishers, (P8), Glencoe, Illinois.

MONEY By mail. Tested money makers. Start your own business, 25c. C-T Sales, Box 208, White Plains, N. Y.

150 AMAZING Money making secrets. Free samples. Formico Novelty Service, Dayton, Ohio.

RECAST Old batteries into new. Latest achievements. Battery Laboratories, St. Paul, Minnesota.

PERFUMERS Make big money. Start small, grow large. Small capital—profits large. Write quick for free folder explaining all. Dr. Abell, Slavin Bldg., Pasadena, Calif.

CONVERT Tin cans into steel scrap and valuable tin by chemistry. Cash markets. Write today for process, 50 cents. Harry Cater, 1601 East 14th Avenue, Denver, Colorado.

START Home Mailorder Business. "25 Lesson Course 25c." Ideal Service, 98, Park Ridge, Ill.

CUBAN Information Bureau. Everything relative to, or about Cuba, reliably investigated and conscientiously done at moderate fees, backed by legal or official evidence. No charge for the first inquiry. Confidential, commercial, industrial, mineralogical, political, historical, legal statistical or personal information furnished. References exchanged. Information Department, Cuban American Brokerage Company, Apartado 566, Havana, Cuba.

TURN Tin cans into money. Instructions 25c. H. Chaney, 1130 E. 16th St., Jacksonville, Fla.

REFLEX Lawn mower blade keeps mower always sharp. Give size. Sample 50c. Reflex Blade Co., 420 Cherry St., Scranton, Penna.

FREE—"Lucky 15 Golden Opportunities." Vital, reliable information about operating a mail order—mailing business including sources, free circulars and free mailing of your offers. Absolutely free to those sending 25c for three leading monthly moneymaking opportunities magazines. Unbelievable bargain or money refunded. Mailad Service, Mooresville, Ala.

POPCORN Machines, caramels, crisp-ettes, cheese coat, potato chips. Long Eakins, 2035-H High St., Springfield, Ohio.

MAIL Order business course shows you how to make money, spare or fulltime. Teaches professional mail order technique—not penny-catching schemes. Free details. Nelson Company, 500 Sherman, Dept. 404-H, Chicago.

MAILMONEY Facts. Outstanding mail-order magazine. Sample copy, big mail, 10c. Vernon Specialty Co., West Fairview, Penna.

ST. CLOUD Granite samples, red or gray. 2" square, initials engraved 50c. Box 553, St. Cloud, Minn.

A LITTLE Gold mine. Repair, refinish, upholster broken or discarded furniture. Very small capital needed. Complete information and working instructions \$1.00. Monarch Upholstery Shop, 2517 La Salle, Los Angeles, Calif.

"RUBBER Mold Making." Plaster Casting. Working instructions 25c. Ideal Service, RM-3, Park Ridge, Ill.

COMPLETE Used brass moulding outfit, only \$200.00. Write for list of equipment included. Youngs & Co., Newburgh, N. Y.

START Mail order book business new way. I've made thousands yearly by it. Complete particulars free. Economy Publishers, 15-P Park Row, New York.

OPERATE Legitimate amusement machines. Investment required. Box 1591, Rockford, Illinois.

YOU'LL Like resilvering mirrors, reflectors, making chipped glass nameplates, signs. Write Sprinkle, Plater, 127, Marion, Indiana.

M. M. Earned \$1174 in spare time for exceptional "cellar crop." Snow-King mushrooms! Free book tells if your cellar, shed suitable. We buy crops. United, 3346 Lincoln Ave., Dept. 62, Chicago.

GRIND Lawn Mowers! Factory method. \$2.00 capital, \$800.00 reported. De Lambert, Janesville, Wis.

OPERATE A collection-credit bureau. Very profitable. Permanent. Free folder. Cole Associates, Syracuse, N. Y.

START Potato chip business in your kitchen. There's money in potato chips for everyone; also Krispy cheese chips, golden corn chips; 3 formulas, 50 cents; guaranteed. Joe Syc, 2712 Geimer, Detroit, Mich.

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UP To \$25,000 reported using schemes, tips, opportunities, formulas from "Schemer" Magazine, Alliance, Ohio. Copy, 10c; trial six months, 30c.

LEARN To mottle furniture, walls, woodwork. Imitate parquet floors. Quickly taught with our formula, minute drying paint. Instructions 50c cash. Kay Laboratories, 1064 E. 14th St., Brooklyn, N. Y.

CLEVER Publishing proposition. Make money, spare time. Bulletin 10c. E. De Witt, Orchard Park, N. Y.

MOLD Making, plaster casting, tremendous profits. Foolproof rubber. 24 page instructive catalogue free. Plastic Arts, 711 Neely, Muncie, Indiana.

BIG Mail for you. Latest moneymaking offers opportunities, catalogs, magazines. Name listed in directory 10c. Ideal Service, 108M, Park Ridge, Ill.

HANDY Men—Earn money home operating Community "Fix-It" Shop. Stafford, Makanda, Illinois.

MAIL Order opportunity. Small investment starts you. Complete instructions 25c. Morse Publishers, Box 671, Cincinnati, O.

MAKE Artificial marble. Novelties, floors, pottery. Cement secrets. Brilliant sample 3c. John A. Fayn, 945 Grande Vista Avenue, Los Angeles, Calif.

CASH Paid for insects. See Sinclair display advertisement on page 10A.

SMALL Capital starts "route" coin operated peanut, gum and amusement machines. Particulars free. Robbins Co., 1141P DeKalb Ave., Brooklyn, N. Y.

MAKE Money developing films, prints, outfits include instructions, write for prices. Johnson's, Box 1562, Baltimore.

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NEED Money? Do you have a worthwhile idea or business in mind but lack capital? Our complete course of instructions—"How to Control and Operate a Business Without Your Own Capital"—should solve your problem. Only \$1 postpaid. A. Shaw, P.O. Box 26, Jamaica, N. Y.

OPERATE Mail order business at home. Details dime. Maples, 3418 South Marshfield, Chicago, Illinois.

AFTERNOONS Free! Work home! \$1,000 month reported (exceptional case—fulltime). Also wartime plan! Expect surprise! National, BX 1240-Z, San Bernardino, California.

RAISE Angora rabbits—Safe home business, easy, reasonable care. Wool sales guaranteed. Small capital. Authentic information. Maurice B. Sixby (Pioneer Breeder), 94 Melrose, Buffalo, New York.

YOU'LL Like the candy business—we help start you, furnishing outfits and instruction. Operate "Specialty Candy Factory" home. Men-women, opportunity for good steady income. All or spare time. (Our 31st year.) Booklet free. Ragsdale Candies, Drawer 4, East Orange, N. J.

MANUFACTURER'S Exclusive formulas; specialties-merchandise information, duplicating latest popular branded products! Miller's Laboratories, Tampa, Florida.

WANT More business! 2c daily opens individual New York branch office. Co-operative Mail Service, 126 Lexington Ave., New York.

A SHORT-CUT To continuous profits through new, permanent business. No competition. Small investment and thereafter a lifetime business of your own with extraordinary profits. Skeptical? Good! Write for eye-opening details. A chance of a lifetime. Kenneth Fleck Company, 306 Wallace Avenue, Columbia City, Ind.

RUBBER Mold bargains brings Xmas business. Colonial Arts, Derry, N. H.

WIN Money! Prizes! Contest Magazine 10c. Butler, 473PM, Sebring, Florida.

SIGNS And showcards easily and expertly painted with letter patterns. Many sizes and styles. Write for descriptive folder. John Rahn, A1330 Central Ave., Chicago.

MEN—Women, operate "specialty candy factory" home, all or spare time. Opportunity for good steady income. (Our 31st year.) Ragsdale Candies, Drawer 62, East Orange, N. J.

GRAPHITONE A super lubricant relieves sticky valves, reduces friction, and ends carbon. Used in gasoline and oil. Be independent, make big money, sold in quart cans. Formula with state rights and territory. Wire or write Arthur Oils, Maywood, California.

MAKE Money with personal service bureaus! No investment needed. Twenty different ways to begin immediate financial independence. Simple, smart, practical. 25c. Berton Strickland, Box 427, Longmont, Colorado.

135 SINGLE-INGREDIENT Formulas, \$1.00 postpaid, B. Kinford, Wayne, Penna.

"NEW Business" opportunities. Drop postal. Porter, Box 6346P, Pittsburgh, Penna.

WE Successfully sell inventions, patented and unpatented. Write us if you have a practical, useful idea for sale. Chartered Institute of American Inventors, Dept. 4-C, Washington, D. C.

I WANT To send you proof of the wonderful pulling power of Popular Mechanics Magazine's classified pages. What's your proposition? Write me today. F. W. Johnson, Manager Classified Advertising, 200 E. Ontario St., Chicago, Ill.

MAKE Color-glazed concrete pottery, gravestones, tiles, floors, walls. Basement waterproofing, etc. Booklet 3c stamp. National Pottery, Minneapolis, Minnesota.

GET Big mails—Samples galore. Your name listed in Midstates Mail Trade Directory, copy sent you, directory 500,000 articles wholesale, 10c. Eagle, 414-P W. 65th, Chicago.

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INVENTION Finance Magazine, 80-G Wall Street, New York. Important particulars free.

A REAL Future for you with Red Comet fire control products. Low prices. Proved seven years. Splendid sales outfit free. Some good territory open. Exclusive. Write quick. 768 Red Comet Building, Littleton, Colorado.

MANUFACTURE From Phospholene, Bleach 2c gallon; glass spray 1c gallon; hand soap 2c pound; and ten fast sellers. Sample 25c. Details free. Western 401 Climax Bldg., Cleveland, Ohio.

SUCCEED With your products. Make-sell them. Formulas, Processes, Accurate analyses. Catalog free. B. Thaxly Co., Washington, D. C.

PLASTEX Industries offers industrious men an opportunity to start a business of their own, manufacturing art goods, novelties, souvenirs, etc., in Plastex and marble imitation. 5c material makes \$1 articles. Rubber moulds furnished for speed production. Small investment brings big returns. You are just in time for big wholesale season now starting. Write for interesting booklet mailed free. Plastex Industries, Dept. A, 1085 Washington Ave., New York.

GOOD Paying business silvering mirrors, plating autopaarts, reflectors, bicycles, bathroom fixtures by late method. Free particulars and proofs. Gunmetal Co., Ave. H, Decatur, Ill.

ELITE Collection of business plans, contains 127 tested plans and scores of formulas. Start own business; home, office. Particulars free. Elite Co., 214 Grand St., New York.

WHERE To buy at lowest wholesale prices. Information free. Yorena, Box P-312, Bayonne, N. J.

100 PROFITABLE Mail order and local plans. Gilbert Supply, 5-P West 24th, New York.

MAKE Sell luminous paint. Literature free. Gordon Laboratories, 1265-H Broadway, New York.

EARN Money in your spare time taking subscriptions to Popular Mechanics. Unlimited possibilities, every family a prospect. Easy to sell. Bonus paid in addition to liberal commission. Send postcard for further details today. Circulation Dept., Popular Mechanics Magazine, 200 E. Ontario St., Chicago.

127 WAYS To make money, in home or office, business of your own. Full particulars free. Elite Co., 214 Grand St., New York.

HOW And where to obtain capital fully explained, free particulars. Star Service, Wapakoneta, Ohio.

MAKE Money by mail, the way we do. Free information. Maywood, P-1107 Broadway, New York.

SECURE Financial independence by placing coin operated merchandise vending machines, out on percentage basis, no experience required. Little capital needed, write for free details. Torr, 2047½ South 68th St., Philadelphia, Pennsylvania.

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RELIABLE Men to operate movie circuits in theatreless communities. Earn \$50.00 to \$100.00 weekly. Everything furnished. Southern Visual, Dept. PM-13, Box 2404, Memphis, Tennessee.

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PROFITABLE Proposition; real money getter; local agents, mail order. Write Bruso, 703 Robinson, St. Clair, Michigan.

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3 NATIONAL Mailorder magazines crammed with moneymaking information—25c. Single copies 10c. International, Box 5636, Chicago.

MONEY Making ideas. Samples and particulars free. Tobiasen, Ree Heights, S. D.

"LUMINOUS Paint" shines in dark. Easily made. 300 other formulas, plans—all 25c. Ideal Service, 309PB, Park Ridge, Ill.

YOU'LL Like resilvering mirrors, reflectors, making chipped glass nameplates, signs. Write Sprinkle, Plater, 287, Marion, Indiana.

EXTRAORDINARY Moneymaking ideas! Worldwide propositions; stamp appreciated. Worldwide Service, Box 5450, Metropolitan Station, Los Angeles, California.

BOOKKEEPERS Make money operating new copyrighted bookkeeping service. Ralph Lee, Vicksburg, Michigan.

FREE Formula. Successful lube reclaiming. Bolset, Box 483, New Orleans, La.

MAKE Money, others do. collecting reptiles, toads, frogs. Easy! Profitable! Sure! We buy all varieties. Particulars dime. Biological Research Laboratories, Dept. 3E, Little Rock, Arkansas.

BUY Wholesale—Sell by mail or local. Wetzel, Valhalla, N. Y.

MAKE 600%. Plan 25c. Nubia Company, 770 Columbia Road, Washington, D. C.

CONTEST Bulletin. Sample copy 10c. 1609 East Fifth, Duluth, Minnesota.

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CASH Paid for insects. See Sinclair display advertisement on page 10A.

A QUALITY Mail of money-makers. Magazines, formulas, plans. No trash. 10c. Goodeve, Bergenfield, N. J.

FREE Literature describing many money making plans. Franklin, Box 866M Hilltop Sta., Columbus, Ohio.

HOME Built mailorder business. Like mine. Start you. Information. Stamp. Frank H. Battles, Ann Arbor, Michigan.

EARN Money taking magazine subscriptions. Details free. New York Circulation Service, 30 Church, New York.

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AFTERNOONS Free! Work home! \$1,000 month reported (exceptional case—fulltime). Expect surprise. National, BX 1240-M, San Bernardino, Calif.

LEARN Making perfect models of buildings, landscapes. Profitable business, hobby. Unique courses, inexpensive. Free particulars. Alfred Weidner, 4589 Lexington, Hollywood, California.

BE A professional scrapbooker. Big fees. Unlimited opportunities. Can be done at home. No competition. No capital needed. Write to Scrapbookers Guild, 59 Park Place, New York, N. Y.

"RAISE Earthworms for profit!" new, interesting home business. Bureau Zoological Research, 106A Broadway, Peoria, Ill.

AMATEUR Cartoonists. earn cash at home. copying and duplicating cartoons for advertisers. Ad-Service, Argyle, Wis.

WHOLESALE Sources. 500,000 articles. Free directory. Maywood, 1107 Broadway, New York.

GROW Plants without soil. Folder free. Gordon Laboratories, 1265-J Broadway, New York.

PROFITS Day-night, year around. No selling. Operate "Silver King"—"King Jr." vendors. \$3.95 up. Free instructions. Automatic, 2425-A Fullerton, Chicago.

FORMULAS, PLANS, ETC.

THAXLY Formulas, processes, for successful products. Accurate analyses. Catalog free. B. Thaxly Co., Washington, D. C.

FORMULAS: — "Chemist Approved." None better. Lowest prices. Catalog free. Kemico, 12-8, Park Ridge, Ill.

FORMULA Guaranteed to kill all ringworm, athlete's foot. 25c. Agnes Luzader, Winnfield, La.

BIGGER Profits—Less work! Single-ingredient formulas. Write A. Kinford, Wayne, Penna.

SPECIAL Course on manufacturing of shoe polishes, by a French specialist, \$25.00. Write, Jules Janelle, 1420 Blvd. Mt. Royal W., Outremont, Montreal, Can.

FORMULAS, Candy lessons, opportunity books. Literature free. Baran, Bay City, Mich.

MEATLESS Roast beef—Six meatless meat formulas 25c. NuWay Foods, 139 1/2 Chandler, Jamestown, New York.

DISTRIBUTORS Sell competitionless necessity. Territory. Information, sample, 20 cents. Weidenbeck, 337A Irving, Brooklyn, N. Y.

AFTERNOONS Free! Work home! Expect surprise! National BX 1240-K, San Bernardino, Calif.

MANUFACTURE Motor tune up oil. Formula. Schafer, 547 Melrose, Chicago.

ANALYSIS. Guaranteed duplication. Formula Messengers, free! Miller's Chemicals, Tampa, Florida.

ICELESS Ice! Colder! Cleaner! Cheaper! Instructions 25c. Duffy, Covington, Ky.

FORMULAS—All kinds. Real money-makers. Lowest prices. Catalog free. Clover Formulary, 108-P3, Niles Center, Ill.

REAL Manufacturing formulas. Lists free. Cummings, Chemist, Gordon Avenue, Syracuse, N. Y.

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FREE Chemistry catalog. Supplies at 5c! Equip complete laboratory. Kemkit Scientific Corp., 397P Bridge St., Brooklyn, N. Y.

CHEMICALS, Laboratory, glassware, apparatus. Send 3c for catalog CPl. Biological Supply Company, 1176 Mt. Hope Avenue, Rochester, N. Y.

SPECTROSCOPE For quick chemical analysis \$2.50. Kutting Sons, Campbell, California.

CHEMICALS In 5c quantities. Catalog 5c. Fleischer's Laboratories, Medford, Mass.

HELP WANTED

LOCAL Agents wanted to wear and demonstrate suits to friends. No canvassers. Partial payment plan. Up to \$12 in a day. Experience unnecessary. Valuable demonstrating equipment, actual samples free. Stonefield Corp., 1300 Harrison, Dept. H-817, Chicago.

USE Photo stamps on employment applications, personal letters, business cards. \$2 buys 150, gummed. Send photo to N. P. Co., Box 6, Niagara Square Sta., Buffalo, N. Y.

M. M. Earned \$1174 in spare time for exceptional "cellar crop" Snow-King mushrooms! Free book tells if your cellar, shed suitable. We buy crops. United, 3848 Lincoln Ave., Dept. 63, Chicago.

MEN, Women. Full or spare time. Finn, 2602-A Gerritsen Avenue, Brooklyn, N. Y.

GET The job you've dreamed of. We assist talented, industrious, ambitious men and women of all ages. Whether now employed or not. Job consultants that make good—not employment agency nor application-letter writers. For eye-opening booklet address Gatto Associates, Trenton, N. J.

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WONDERFUL Invention brings joy to women who iron! beats electric! proven seller! good profits up \$100 weekly. Write Finn, 330 Mt. Prospect, Newark, New Jersey.

MAKE Extra money easily. Sell 50 assorted personal Christmas cards for only \$1. 14 box assortments 30c up. Odd cards 25c each. Send for free samples exclusive \$1 line personal cards and imprinted stationery. Request \$1 assortment on approval. New England Art Publishers, North Abington, 331, Mass.

INSTANT Sales. New patented room perfumer. Snaps on any light bulb. Uses solid perfume. Lasts for hours. Constant repeat sales on refills. Send 25c for complete sample. Lyndon Products, Norwalk, Conn.

CALL On friends with sensational lowest-priced personal Christmas cards and stationery. Names imprinted. Also big-value 21 card \$1.00 assortment. Profit, 50c. Experience unnecessary. Samples free. Wallace Brown, 225 Fifth Ave., Dept. P-44, New York.

NOVELTY Jewelry. Fast sellers. Send time for sample. Transposter, 729 Boylston, Boston, Mass.

SILVERWARE Cleaned instantly. Simply dip and dry. Amazing demonstrations. 566% profits. NuProcess, Dept. 68, Aurora, Ill.

"I GUARANTEE You can sell" my new automatic floor waxer, cleaner, polisher—all in one. Retail \$1.95. Your profits 100%. Write J. H. Smith Manufacturing Co., Dept. P-7, Springfield, Mass.

CHRISTMAS Cards. Earn \$2 an hour. Take orders galore from friends. 50 exquisite folders with name \$1. Free samples 30 designs. America's fastest selling 21 Christmas folder box. Costs 50c, sells \$1. Request samples today. Sunshine Art, Dept. E-1, 154 Nassau St., New York City.

LONMPOWER Attachment converts any hand lawnmower into complete power lawnmower economically. Agents wanted. Lonmpower, 347 North Crawford, Chicago.

CHRISTMAS Card leader brings you quick cash profits. Sensational "Beauty Queen" 21-card assortment sells \$1.00. You make 100%. Ten other fast-selling assortments. Personal Christmas cards, 50 for \$1. up. Samples on approval. Chilton Greetings, 147 Essex, Dept. T-2, Boston, Mass.

SELL San-Blen signs. Big profits. Sample free. Rister Signs, Abilene, Texas.

HUSTLERS—Easy pitch—Clean deal. For restaurants, taverns, up to 300% profit. Investigate. M. Sheridan, 624 S. Michigan, Chicago.

MILLION Articles. Buy wholesale. Valuable directory 10c. Ideal Service, D-8, Park Ridge, Ill.

EXTRA Cash! Sell Christmas cards—50 for \$1 with name imprinted. New raised colored printing. 21-card assortment \$1—you make 100%. Complete line. Samples on approval. Colonial Studios, 305 Dwight St., Dept. B-11, Springfield, Mass.

FASTEST Selling polishing cloths. Sample, 15c. Matz Products, Reading, Penna.

TWO Steady repeaters, prospects galore. Samples, details 5c. Daufeldt, Atalissa, Iowa.

EXTRA Money quick! Sell super-value personal Christmas cards. 50—with name—\$1. Finest 21-card assortment \$1. You make 50c. Complete line. Samples on approval. Waltham Art Publishers, 160 N. Washington, Dept. 309, Boston, Mass.

AGENTS—Your own hose sent free with big outfit. Amazing guarantee. Silk or nylon. Rush name and hose size. Wilknit, Desk HH-37, Greenfield, Ohio.

SELL 50 Personal Christmas cards—\$1.00. Amazing bargain! 50 folders with customer's name imprinted. Sells fast. Pays big profits. Free samples. Also unequaled \$1 Christmas card assortments. General Card, 400 S. Peoria St., Dept. P-71, Chicago.

CHRISTMAS Cards. Absolutely finest assortment. Season starting. Write for samples. Robinson Cards, Dept. 500, Clinton, Mass.

MAKE Extra money easy. Show smart personal Christmas cards with name, 50 for \$1. up. Outstanding values. Also 21-card assortment, \$1; others. Big profits. Samples free. Wetmore & Sunden, 749 Monroe, Dept. 74, Rochester, New York.

FREE Water and our concentrates make 68 products. Labels, bottles, everything supplied. Quatco, E-20030 Russell, Detroit.

UP TO 500% profit with new perfected 1940 quick action, no flint, automatic gas lighter. Retail \$25c. Sample 10c. New Method Company, Box PMG-93, Bradford, Penna.

SELL Food. Everybody needs food. Own profitable neighborhood business. Complete outfit sent on trial plan. Write for particulars. Ed. Mills, 3571 Monmouth, Cincinnati, Ohio.

BUSINESS Proposition resilvering mirrors, reflectors, making chipped glass nameplates, signs. Write Sprinkle, Plater, 128, Marion, Indiana.

IF You are ambitious you can make good money with a Rawleigh route. We help you get started. No experience needed to start. Steady work for right man. Write Rawleigh's, Box H-2-PPM, Freeport, Ill.

UP TO 100% profit in new perfected 1940 quick action self-starting clear lighter. No flint or friction. Lights easily in the wind. Retail \$25c. Costs you \$1.75 dozen. Sample and can fluid 25c. New Method Company, Box PM-92, Bradford, Penna.

AT Home, your own manufacturing business, making popular \$1 novelties. Cost you 3c to 15c. Everything supplied. Write So-Lo Works, Dept. K-842, Cincinnati, Ohio.

MEN And women wanted, full or spare time to sell Sayman products house to house. Write T. M. Sayman Products Co., St. Louis, Mo. Dept. K3.

500% PROFIT Selling new "20-in-1" kitchen utensil. Retail 25c. Costs you \$1.00 a dozen or \$1.20 a gross. Sample 10c. New Method Co. PMM-92, Bradford, Penna.

CHRISTMAS Card salespeople — Best sellers. You make 50c on new 21-folder \$1 assortment. Christmas cards with name, 50 for \$1. Other big-profit assortments. Experience unnecessary. 50c sample on approval. Schwer, Dept. T-4, Westfield, Mass.

SELL Different Christmas cards—21 for \$1. Free metallic gold seals can be used to "personalize" cards. Make 100% profit. Christmas cards with name imprinted 50 for \$1. Samples on approval. Friendship, 811 Adams, Elmira, New York.

MEXICAN Curios sell on sight. Large profits. Free particulars. Samples 10c stamps. Marquez, P.Y. Apartado 1176, Mexico City.

MAKE And sell your own products. No machinery needed. Amazing profits. Guaranteed "Chemist Approved" formulas. Catalog free. Kemico, 10-G, Park Ridge, Ill.

REVOLUTIONARY Window cleaning tool. Good Housekeeping approval. Only ten \$2.25 sales daily to housewives, factories, schools, stores will make you \$350.00 monthly. Carter Products Corp., 908 Front Ave., Cleveland, Ohio.

CALL On friends with greeting card assortments. Easter, birthdays, other occasions. Big demand. Big profits. Also personal stationery. Experience unnecessary. Samples free. Wallace Brown, 225 Fifth Ave., Dept. K-34, New York.

MEN; Women; full or part time. \$10.00 daily is easy with our sure fire 25c pocket novelty. Everybody needs it. \$1.00 starts you. Refunded if not satisfied. Winton Mfg. Co., 510 Orange St., Newark, N. J.

AGENTS Wanted—Exclusive one county franchises available on our Supercharging Air Filter. Increases acceleration—improves gas mileage. No moving parts. Pair of "supercharged" hood signs free with every air filter. Five minute installation cannot clog up with dirt—sturdily constructed of cast aluminum and iron. Two sizes to fit all popular makes of automobiles. Tremendous market. Big profits. Write for full particulars to Supercharging Air Filters, Room 922, 260 East 161 Street, New York City.

MERCHANTS Wall signs, cost 1c, sell 10c. 3 samples 15c, refunded. Richards, 127-M E. New York St., Indianapolis.

TIP It, knock it over, turn it upside down. The Kant-Spill inkwell does not spill. Sold in combination with beautiful long-life fountain feed pen, writing over 200 words with one dip. Fast selling, profitable item. Sample 60 cents prepaid. Full information return mail. Haarer & Company, Box 389 MO, Lansing, Michigan.

CHRISTMAS Cards. Sell 50 assorted folders, name imprinted \$1.00—Cost you 50c. Samples free. Dunbar, New Brunswick, N. J.

WE Pay you \$5 for selling ten \$1 boxes. 50 distinctive assorted name imprinted Christmas cards. Sell \$1. You make 50c. Free samples. Cheerful Card Co., 51 White Plains, N. Y.

AFTERNOONS Free! Work home! \$1,000 month reported (exceptional case)—fulltime. Expect Surprise! National, BX 1240-N, San Bernardino, Calif.

SELL To building trades. New article; easy sell. Send 25c for sample. Mason and Parrish, Engineers, 2105 N. Burdick Street, Kalamazoo, Michigan.

HOUSEHOLD Necessity costs 2c, sells 25c. Linnell, 14006 Coit, Cleveland.

AGENTS Wanted for window cleaner. Details, Ward, 97B, Saybrook, Connecticut.

EARN Big money. Part-full time, as our exclusive sales agent. Write Dept. G, National Products Company, 175 5th Ave., New York City.

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AGENTS: Smash 90 prices! Santos coffee 12c lb. 4-oz. vanilla 8 1/2c. Razor blades 10 for 8 1/2c. 100 sticks chewing gum 12c. Christmas cards, 21 in box, 14c. 150 other bargains. Premiums. Experience unnecessary. Carnation Company, P.O. St. Louis, Mo.

AGENTS: Stamping names on pocket-key protectors. Sample check with your name, address, 25c. Stamping outfits. Emblem checks, check-fobs, name plates. Hart Mfg. Co., 303 Degraw St., Brooklyn, N. Y.

DEALERS: Sensational seller. In United States. Free sample. Girards, Washingtonville, Ohio.

CALL On service stations. New item, necessity, big profits. Knipp, Long Beach, California.

FREE Sample—Amazing cleaner; sells homes, taverns, everywhere. Big profit—fast repeater. Betco, 5007 Irving Park, Chicago.

BIG Money applying initials on automobiles. Easiest thing today. Free samples. Also, sideline salesmen for short order decalcomania name plates. "Ralco," 1305 Washington, Boston, Mass.

SUCCEED With your products. Make-sell them. Formulas. Processes. Accurate analyses. Catalog free. B. Thaxly Co., Washington, D. C.

DO You want agents for your proposition? Your ad in this space will place your message before hundreds of men seeking fast-selling products. My folder "How to Secure Agents," is filled with proof. I'll gladly send you a copy free. F. W. Johnson, Manager Classified Advertising, Popular Mechanics Magazine, 200 E. Ontario St., Chicago.

MANUFACTURE Specialties, hire agents yourself. Big money. Free literature. Gilbert Supply, 5-P West 24th, New York.

AGENTS—300% Profit selling gold leaf letters: stores and offices. Free samples. Metallic Letter Co., 438-B North Clark, Chicago.

GOOD Paying business silvering mirrors, plating auto parts, reflectors, bicycles, bathroom fixtures by late method. Free particulars and proofs. Gunmetal Co., Ave. N. Decatur, Ill.

AGENTS—Opportunity make money; book containing 127 successful business plans; home-office; send for free introductory booklet. Elite Co., 214 Grand St., New York.

AGENTS Make big profits on food products, bargain deals. Low wholesale prices. Rush name for trial outfit offer. Ho-Re-Co, 2810-T Dodier, St. Louis, Mo.

AGENTS—To mail our literature. Good profits. Home business. Maywood, 1105-1107 Broadway, New York.

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SALESMEN, District managers, state representatives wanted for marvelous new automatic grease cup. Indicates when cup is full or empty. Mammoth sales outlet. See our ad on page 129A. Ace Lubricating Equipment Co., 2345 West Grand Boulevard, Detroit, Michigan.

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SALESMEN: America's finest sideline. 40% comm. daily. 725 fast selling repeat items. Every business uses and must buy. No investment. Sales portfolio free. David Lionel Press, 312 So. Hamilton, Dept. F, Chicago.

FREE Trial to customers. Sells itself! Revolutionary loud speaking inter-communication system. Talk privately, back and forth, to one or any number of stations, even 2,000 feet away. Any station originates calls. One electrical connection. No servicing. Easily installed. Guaranteed. Technical experience unnecessary. Two-minute demonstration. Thousands prospects, factories, offices, automobile dealers, lumber yards, restaurants, etc. We carry the accounts. New low price. Men earning high as \$150 week. Protected territory available. Free demonstrator offer. Inter Communication System of America, 2440 Lincoln Ave., Dept. 309, Chicago.

SENSATIONAL Quick-cash opportunity. My route building plan gives you chance for good steady income. Real future. Handle regular route local stores. Collect, deliver orders for famous 5c—10c counter display goods. Nationally advertised in 120 magazines and radio. Show merchants proven plan for beating competition and increasing sales, profits. Experience unnecessary. Use home as headquarters. Chance to operate Silver Fleet service truck. Facts free. World's Products Co., Dept. 10-B, Spencer, Ind.

WRITE For free sample amazing stain-proof tablecloths. Clean with damp cloth. Require no ironing. Beautiful patterns. Look like linen—cost much less. Commissions big. Also complete line of dresses. Melville Company, Dept. 1629, Cincinnati, Ohio.

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ADVERTISING Book matches—World's largest manufacturer of union label book matches. Fast selling line. Large sales producing kit. Sample matches complete cut catalog. 9 color combinations makes selling easy. Commission in advance. Superior Match Co., 7530 Greenwood, Dept. M-8, Chicago.

CALL On service stations factories, restaurants, businesses, professions; with lettered advertising uniforms, shirts, work suits, etc. 100 styles. Exclusive features. Also soft-ball uniforms. Big advance commissions. Free outfit. Topps, Dept. L-7, Rochester, Indiana.

SALESMEN, Distributors, 200 items. Brushes, mops, marvelous magnetic brush—exceeds vacuum cleaner. Big profits. Neway Brush Works, Hartford, Conn.

SELL Printing at cut prices. 2,000 business cards \$1.50; 1,000 envelopes or stationery, etc. \$1.75; 25 printed sales books \$1.50; 1,000 process embossed cards \$1.50; 2,000 two-color labels, free holder \$1.50; 2,500 printed handbills \$1.75. One-third comm. Free outfit. Bargain Print. Co., 189-F W. Madison, Chicago.

SELL Candidates! America's largest line of political auto signs, stickers, posters, novelties. Very little competition. Ad-Nor-Co., Newton, Iowa.

COMPLETE Line everyday business necessities—Over 2000 items at big money saving prices. Experience unnecessary. Samples free. Commissions advanced daily. Northwestern, 625-BK Jackson, Chicago.

IT'S Hot! Big repeater with plenty immediate and repeat commissions. No investment. Sells to every type retail dealer and service station. Sales kit free. Hurry! Universal, 2223 Diversey, Dept. C58, Chicago.

ADVERTISING Book matches offer liberal earnings—full, spare time. Experience unnecessary. Factory direct. Low prices for fine quality, quick deliveries, help get orders; faster repeats. All business firms prospects. Free outfit, instructions. American Match & Printing Co., Dept. 68, 4822 South Trumbull Ave., Chicago.

ONLY Two sales per day makes over \$1200.00 monthly profits. Auto tools. Every mechanic a prospect. 95% virgin. \$50.00 sales makes \$36.00 profits. New. Proven. Protected territory to producers. Year around demand. Mesco, Beaver City, Neb.

BIG Commissions—selling to stores celluloid pricing tickets, metal shelf moulding. To restaurants, menu covers, signs. P. Pricing Press, 124 White St., New York.

TIRE Accessories. Guaranteed 10,000 mile Tiger Grip tire patch, and fast-selling line tire accessories. Salesmen-distributors easily earn up to \$60 weekly, selling garages, service stations, etc. Protected territory. Economy Rubber Products, 701 Burkhardt, Dayton, Ohio.

\$300 PROFIT Next month on \$425 sales. America's finest automatic fire protection. Largest commissions. Complete line. Territories, PyroTector, Bradley Beach, N. J.

DISTRIBUTORS, Crew managers, organizers of agents, send quick for news of amazingly-seasonable device for traveling autoists. Thirty-five cents retail or more value. Quick easy seller. Light, permanent. Immense commissions. Write or wire for details. Also can use few lone salesmen in unoccupied districts. Act promptly. Nicholas Company, 7137 Cottage St., Philadelphia, Penna.

SELL Songs, postcards, calendars. Commission. Write G. Mayer, Lake Mary, Florida.

CALENDARS All sizes—Orders are being placed now for 1941 calendars, advertising fans and novelties. Free samples—get started now and book those early orders. Fleming Calendar Co., 6543 Cottage Grove, Chicago.

NEW Specialty—Sells every business and professional man. Four \$15 sales daily pay \$280 weekly. Farrell cleared over \$1,000.00 monthly. Write P. E. Armstrong, President, Dept. PM, Mobile, Ala.

BLADES—Big profits. Best quality. Factory prices. Postpaid. Ace Blades, Buffalo, N. Y.

A REAL Future for you with Red Comet fire control products. Low prices. Proved seven years. Splendid sales outfit free. Some good territory open. Exclusive. Write quick. 704 Red Comet Building, Littleton, Colorado.

EXCELLENT Opportunity selling our complete line of brushes, largest commissions. Write for sales plan. Wire Grip Sanitary Brush Company, 2300 5th Ave., New York.

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U. S. Gov't jobs pay up to \$40 a week to start. Get ready for next examinations; railway postal, rural carrier, mail carrier, office help and others. Free book tells how you may qualify. Write quick. Patterson School, Dept. P. M., Rochester, N. Y.

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WATCH Repairing is steady profitable work. Experts usually in demand. You can learn watchmaking trade at home, spare time. New original instruction system. Script engraving course included. Write for free details today! Nelson Co., 500 Sherman, Dept. H-2001, Chicago.

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TELEPATHY. Productive, distinguishing study. Dr. Green, Box 1177-pm., San Francisco, California.

TURN Muscles into cash. Get health that leads to wealth. Knoff, 2154 M. D. North 52nd Street, Milwaukee, Wisconsin.

HOME Study for degree. Psychology, Metaphysics, Philosophy, Bible. Free information. College of Universal Truth, 20-B East Jackson, Chicago.

MEN—Women. Get U. S. government jobs. Commence \$105-\$175 month. Prepare immediately for examinations. Experience usually unnecessary. Full particulars—list positions, free. Write today. Franklin Institute, Dept. G3, Rochester, N. Y.

ACQUIRE Emotional stability! Nervousness, fear, bashfulness—afflicted? Free, inspiring information. Writel John Englund, Ironwood, Mich.

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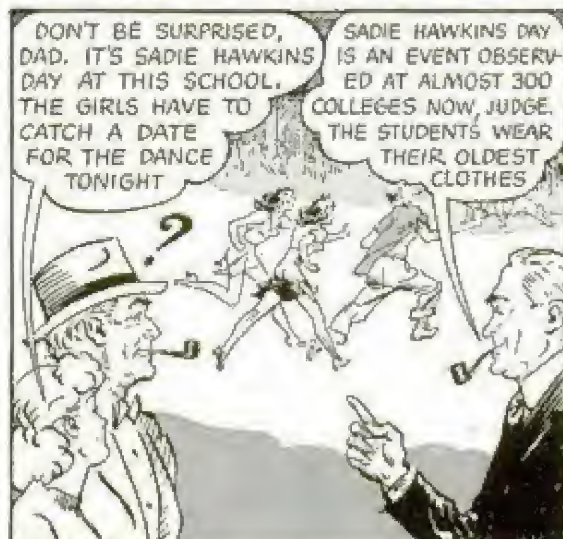
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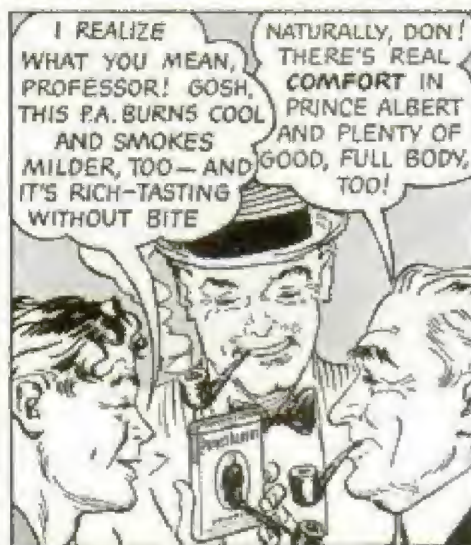
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WRITTEN SO YOU CAN UNDERSTAND IT

Vol. 74

AUGUST, 1940

No. 2



German dive bombers of the type pictured above played a big part in forcing Dutch and Belgian capitulation and in fighting Allied navies. German tanks that threw a stream of flames seventy yards were used in the march to the channel; at left is an Italian army flame thrower

By R. Ernest Dupuy
Major, U. S. Field Artillery

LESS than a year ago a siren voice was heard: "Stay on the defensive—modern weapons are so murderous that whoever takes the offensive is doomed." A part of the world believed; another part—professional soldiers these—disbelieving, found themselves without an audience.

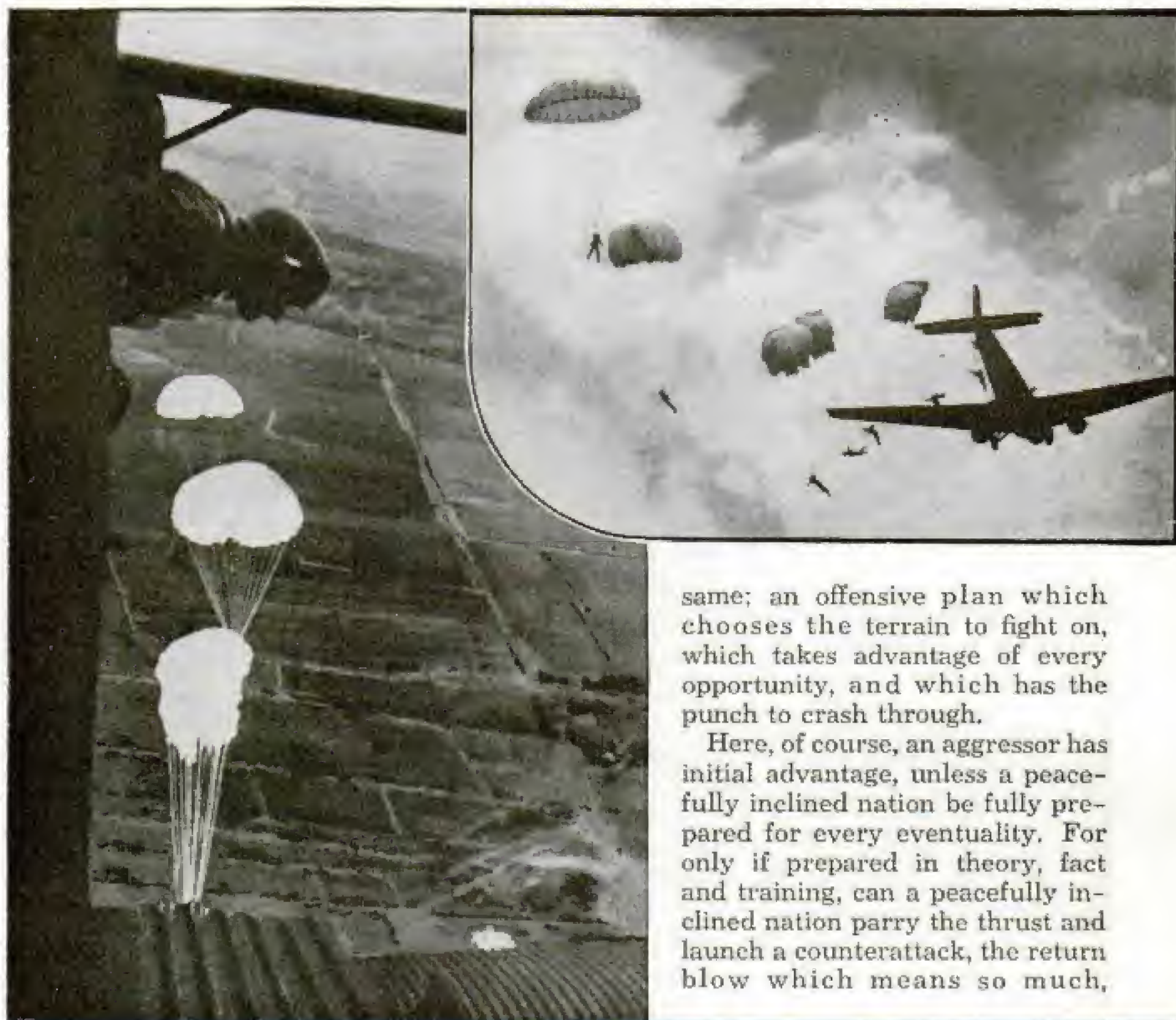
Distrust history, sang the siren. Forget Genghis Khan, Frederick the Great, Washington's sweep to Yorktown, Napoleon's 1805 campaign to Austerlitz, Robert E. Lee in the Shenandoah Valley, Grant before Vicksburg and again at Appomattox, Allenby in Palestine. Forget that surprise, speed and striking power offensively used have won every previous campaign. Today that siren is silent. An amazed world prates

AUGUST, 1940

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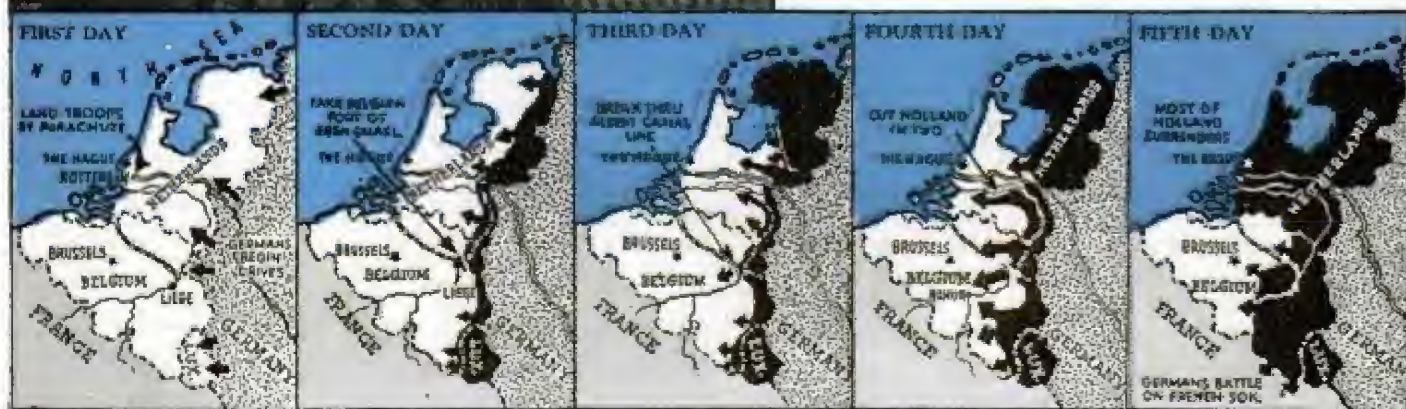
Public Relations Office,
United States Military Academy

R601



same; an offensive plan which chooses the terrain to fight on, which takes advantage of every opportunity, and which has the punch to crash through.

Here, of course, an aggressor has initial advantage, unless a peacefully inclined nation be fully prepared for every eventuality. For only if prepared in theory, fact and training, can a peacefully inclined nation parry the thrust and launch a counterattack, the return blow which means so much,



In warfare of old the spy and the cavalry worked behind enemy lines and made forays into enemy country. Today parachute troops (top) bail out of big transports with guns, supplies, even bicycles to sabotage and prepare the way for the army. Below, timetable of German blitzkrieg

of blitzkrieg, the lightning war, as something new under the sun.

This is an error. What is new is the technique, the utilization of scientific advances—mainly the internal-combustion engine and everything it made possible—which has geared warfare to a heretofore unthinkable rapidity of movement. The basic elements of success in war remain the

whether in the boxing arena or in war. To realize this, one must see just what this blitzkrieg amounts to, and what are the parries by which the attacked can check the blow, in order to strike back.

There are several essential ingredients to the successful blitzkrieg. First, you must be prepared. Second, you must know where you want to go. Then you must



know not only the hostile strength and where it may be expected, but also every hill and valley, every road, river, bridge, every village in the area. You must know how the enemy gets his food and water, all his vital necessities, so that he can be throttled by their disruption. This knowledge is obtained by map study, by travel in his country, by careful check of all his resources of supply and manufacture. Only then will you be prepared, in striking, to disrupt all enemy efforts to resist.

The next step is study of the enemy terrain. Relief maps of the area are prepared, over which officers pore to thrash out every possible angle of opposition. Far in the interior of your own country maneuvers are carried out simulating all the difficulties which must be hurdled. These include incessant drilling of the combat teams—tanks, airplanes, infantry and artillery—until, so far as is humanly possible, each man knows exactly where to go and what to do. This must be done on terrain closely resembling the scene of action. The enemy language must be studied, in elementary form at least.

If an overseas expedition is planned, the advance ground elements must be drilled in loading and unloading the transports. Into each vessel



must go an equal distribution of men and materials. What good dumping a battalion of infantry on the beach if it does not have the necessary ammunition, rations, machine guns and supporting artillery? The naval forces must plan and rehearse their part; the air troops—combat, reconnaissance and transport planes—must be picked and rehearsed; the parachutists must go



Parachute riflemen (top) rush for a container of supplies dropped to them; they carry gas masks and full fighting equipment (right) on their aerial invasion. Below, parachutists form into fighting unit



through their maneuvers. Warfare today is so complicated by mechanization that nothing can be left to chance.

The dress rehearsals completed, you launch the blitzkrieg. Rolling on every highway leading into enemy country come the juggernauts—tanks, led by armored cars and closely followed by motorized infantry and artillery. Overhead the bombers have already laid their eggs on hostile airdromes and vital centers. The enemy's covering forces give what battle they may against the flaming chariots. But hedge-hopping over the trees come the whirling dive bombers to blister with bomb and machine guns and light cannon every spot of resistance.

Does the road-net cross a river? Then the 400-mile-per-hour dive bombers must sow death and destruction about it, to stun its defenders, while out of speedy transport planes bail the parachute troops which, on landing, rush to the key point—the bridgehead, the powerhouse, the dike control—to fight off opposition until the tanks catch up. The "fifth column," your own agents and sympathizers, assist in this preliminary, seizing telephone centrals, spreading false alarms, giving contradictory orders, sabotaging waterworks, light plants, broadcasting stations and railway switches.

Knowing the location of every air field in the hostile terrain, you may, at the same time, actually land transport planes where necessary, to aid the "fifth column" and the parachutists in capturing key points. And by judicious bombing of centers of population, hordes of terror stricken refugees will be driven out to clog the roads leading toward the interior of the enemy's country. Their presence will impede the advance of reinforcements, and may delay

Top, inflated rubber boats carry troops across rivers and take them ashore from seaplane transports alighting in enemy country. Below, light tanks on the march; heavily armored, the German tanks and cars resisted ordinary anti-tank shells

near Aachen Germany



Above, motor launch pulls string of rubber boats carrying a battalion. Right, U. S. anti-aircraft guns roll beneath big bombers; below, glimpse inside a French seventy-ton tank; bottom, U. S. army tanks

his demolition squads in blowing up bridges, tunnels and causeways, for it is but natural to suppose that he will hesitate to cut off his own citizens from safety.

Should the bridges be blown up, that will of course impede your swift-rolling columns. But, remember, you are proceeding with a definite plan, and on a wide swath of roads. The momentary halting of a column does not hinder its neighbors on other roads—whether the halt be due to hostile resistance or to obstacles. Like the tide which swirls around the rocks, the advance continues. The reconnaissance planes hovering over the head of your columns are carrying back word of all such hindrance. Dive bombers will harry the islands of resistance, the engineer detachments making up part of the mechanized columns soon will make temporary repairs to bridges or lay ponton bridges.

Collapsible rubber boats carrying four or more men may be carried by transport planes or by trucks, to be put to quick use. Or they may be carried by the big flying boats with which you make a lightning swoop on a harbor or wide river, to enable the first detachments to paddle ashore and seize the key points.

The essence of the first move, then, is surprise. Surprise brings uncertainty and disorder in its wake, disrupts all the normal life of the invaded country. To be stronger than the attacked, particularly in the air, is essential. You don't make a blitzkrieg unless this is reasonably certain. The strongest body is powerless if its nerve-centers be cut. Successful blitzkrieg does just this.

How long you can keep up this lightning war is dependent upon fuel, ammunition

(Continued to page 141A)



Printa Cunningham C. D.

Electric Brain Plays Game with Fair Visitors

Offering a challenge to all comers in the ancient Chinese game of Nim, or fan-tan, a one-ton electric brain, called the "Nimatron," matches its wits with visitors at New York world's fair. As the game is usually played, each player alternately picks up a number of match sticks or counters from a single pile until one of them has picked up the last match and won. But the Nimatron substitutes rows of electric lamps for stacks of matches. The machine's opponent pushes a button to turn out as many lights as he chooses, and the mechanical brain, consisting of two miles of copper wire and 116 relays, then makes its selection and turns out more of the lamps, which is continued until the last one is turned out. Research men at the Westinghouse laboratories, where the machine was built, explain that the visitor must be able to think in powers of "two" of the binary system of numbers, if he expects to be a consistent winner.



Rows of lamps above "Nimatron" show the status of game being played as visitors at New York fair pit their wits against one-ton electric brain

Fast Navy Torpedo Boats Fight Warship or Submarine

Thirty-one fast torpedo boats are being completed as an experimental patrol fleet for the United States Navy. Ranging from fifty-nine to eighty-one feet long, the boats are to be armed with torpedo tubes, machine guns, depth charges and apparatus for laying smoke screens, so they will be capable of fighting enemy surface ships or submarines.



First of the Navy's experimental fleet of coast-patrol torpedo boats, the "PT-3" hit forty-six miles an hour in its test run on Detroit river

15 & 69 St. New York City

Non-Inflammable Paper Resists Oil and Water

Folding pots and pans made of non-inflammable paper, in which water may be boiled, are some of the possibilities offered by a recent invention. To show that fire and water do not harm his fireproof paper, an inventor boiled water in a single sheet which he held over a burning candle. Being resistant likewise to oil, and easy to disinfect, the paper is said to be well suited for use in Braille books, since perspiration from fingers of the blind will not damage the raised characters. Perhaps even more important, according to the inventor, would be its military applications.

Water being boiled over candle flame in sheet of fireproof and waterproof paper in order to demonstrate its qualities. The paper also resists damage by oil, and the inventor offers it for military use



K 593.

Straps Hold Runner on the Mark until Starter Fires Gun

Temple University Phila



This athlete cannot start his dash until straps release him, which occurs when starting gun is fired

Runners who attempt to jump the gun are held in check by a new starting gate invented by a university athletic coach. Straps, serving as barriers to prevent false starts, are released automatically when the starting gun is fired.

K 589

Light Bulb with Reflector Inside Is Economical in Wattage

Blown in a parabolic shape to direct all its light upon the working area, a new type of electric-light bulb has its own self-contained reflector. The silver plating is on the inside of the bulb where it is untouched by dirt or fumes. It is especially useful where concentrated light is required. With its parabolic shape and built-in reflector, lower wattages can be used.



Dr. W. Coach Ben Ogden

Chas. P. photo

Remata Innes

Solar

Warren Lamp Co. Pa. Warden

QUICKER *than a* WINK..



Courtesy Hale, Cushman & Flint, publishers of "FLASH!"
—Seeing the Unseen by Ultra High-Speed Photography,
by Harold E. Edgerton and James H. Killian, Jr.

Aviation designers may learn from insect's flight; top, high-speed photographs catch locust's wings on upstroke, half-way and start of downstroke. Left, kicker's toe "stopped" as it drives deep into football



where Dr. Harold E. Edgerton and a group of scientists have been experimenting in ultra high-speed photography, they often use the phrase "slow as a wink"; half in fun, of course, though it does give them a valuable commonplace standard of comparison to explain the wonders they have achieved.

To these research men, who have been dealing with velocities too great for the mind to encompass, the "batting of an eye" is slow motion. A wink, they have found, by counting the frames of film exposed in a high-speed motion-picture

THAT time-worn phrase, "quick as a wink," has always meant incredible speed to man. Indeed, the involuntary operation of the eyelid—the shutter on that human camera called the eye—seems very fast when measured by the antiquated standards of the eye itself.

But in the laboratories of the Massachusetts Institute of Technology in Boston,

camera, usually lasts one-fortieth of a second. They have taken pictures with an exposure of $1/3,000,000$ of a second. The use of a light flash accurately timed to last $1/1,000,000$ of a second to take photographs is as commonplace to them as dishwashing to a housewife.

You will probably continue to say "quick as a wink" after you have noticed some of

*Judges of Olympic trials
professional basketball*

120 E. 34th New York City

and then **SOME!**

Leakage of powder (below) redented by photo taken at 1/1,000,000th of second exposure. Right, showing bat actually bends in striking ball. Inset, panishment taken by ball. Bottom, left, bullet before striking steel plate. Right, lead bullet spluttering like a liquid upon hitting plate



the "frozen motion" photographs a major newspaper picture syndicate is beginning to produce by the Speedray process, an adaptation of the professor's experiments.

But you will realize what an absurdly laggard mechanism the eye really is after you have seen pictures of diving swimmers suspended as if in flight, leaping basketball players who appear to be hanging in midair and actual action prize-fight scenes which are so much like stills from Hollywood studios that they appear posed.



Intermingled new photo new speed clay lamp

defeated Long Island at Madison Square Garden



and ship propellers, spindles and looms of textile plants, fans, guns and moving automatic machinery of many kinds by matching the rapidity of their motion with the rapidity of his camera. Thus they produce "stop motion" pictures which can be analyzed at leisure.

The manner in which glass breaks, metals cool, liquids flow and air impedes had never been demonstrated accurately until Dr. Edgerton used his portable stroboscopic camera — stroboscopic meaning, roughly, "whirling watcher"—to make motion pictures at the incomprehensible rate of 6,000 a second.

Words like "incomprehensible" and "incredible" are often uttered by

Billy King Lou Weaver

These are produced by what Dr. Edgerton considers a moderately fast exposure of 1/100,000 of a second.

Just as these pictures will show you details of sporting events your eyes would have missed if you attended, Dr. Edgerton's experiments in his laboratory have opened a whole world of unseen rapid motion which is certain to affect the manufacture of the food you eat, the clothes you wear, the household utensils you use, the vehicles you ride in, the dwellings you occupy and the equipment you use for recreation and sports.

Industrial research men are learning to solve some of the mysteries of the machine which the human eye could not fathom, nor could mathematics unravel.

By coupling incredible speed of exposure with intense light developed in his still photography and inventing a motion-picture camera fast enough to use both, Dr. Edgerton and his assistants have enabled the scientists of industry ultimately to disclose mass-production secrets. They are probing the automobile motor, airplane



Press photographer caught fast action in basketball game at 1/100,000 second. Muzzle velocity of a bullet, below, was determined accurately by calculating the distances and times with speed photography

bewildered visitors in the institute's ultra high-speed photography laboratories. So James R. Killian, Jr., an associate and co-author with Dr. Edgerton of the fascinating book "Flash!" which the Boston publishers, Hale, Cushman and Flint, have recently issued, has figured out a few comparisons, like that of the wink, to simplify matters. If you know enough about a



standard camera to realize that it is essentially a box containing a film sensitive to light, that the picture is taken by the admission of a certain amount of light which strikes the film and that the amount of light is regulated by a shutter which opens and closes at a desired rate, you can readily grasp author Killian's explanatory comparisons.

First, Dr. Edgerton uses a standard camera but he eliminates the regular operation of the shutter because it is much too slow. Instead, electrical control of the illumination replaces the shutter. The light is turned on only when a picture is to be exposed, in a fashion similar to taking photographs with photoflash bulbs except that the duration of the flash in a flash bulb is about 2,500 times longer than the $1/100,000$ of a second necessary to "stop" a ball in flight.

To grasp what an exposure of $1/1,000,000$ second means, think of the length of the exposure as the distance across an ordinary room, while the length of a second is the distance between New York and San Francisco.

Next, to get enough light into the camera in such a short time, the illumination must be strong; and so it is, for Dr. Edgerton's flash is brighter than the light of 40,000 ordinary fifty-watt bulbs. Brighter

(Continued to page 132A)



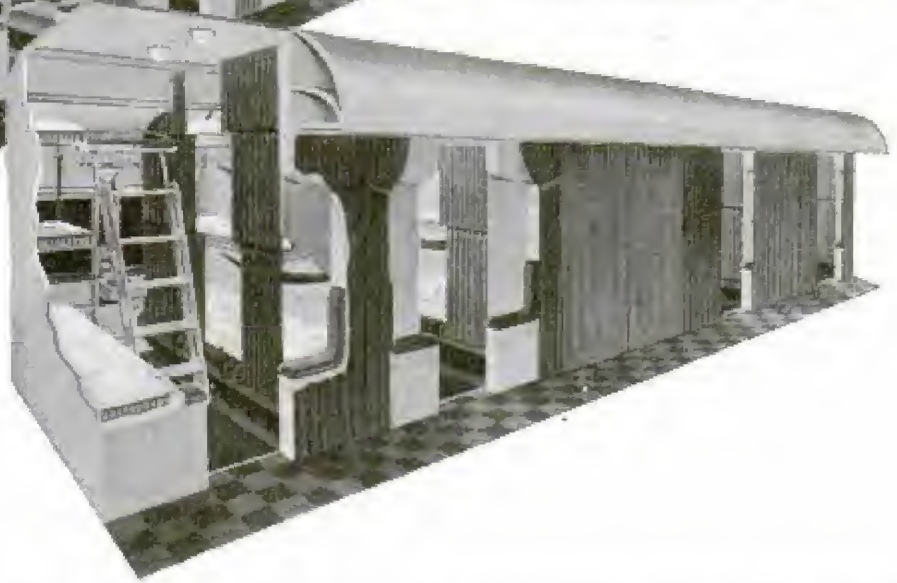
Did you notice the hummingbird stuck out its tongue at the photographer? At upper right, a fast shot over the parallel bars. Below, a speed flash just as the glass crashes on the floor makes the spattering milk seem to flow as slow as molasses

Mass. Inst. of Technology

Low-Cost Rail Sleeper Has Three-Story Berth



Sectional view at left shows six-seat section of coach-sleeper during day travel; notice that uppermost berth is curtained off but not folded away. Below, the same section at night, with facing tiers of three-deck berths made up. Middle berth extends downward from upper



Midsummer travel finds an entirely new type of sleeping car on the rails—the coach-sleeper. Built experimentally to offer low-cost sleeping accommodations for the traveler who has been patronizing the bottom-rate day coach, the coach-sleeper introduces a three-story berth arrangement. On one side of the car is an aisle from which ten compartments are entered. Five of the compartments seat and sleep three persons each; the other five accommodate six persons. In daytime the rooms have three adjustable seats side by side, with arm and foot rests for comfort; the six-seat compartments have three additional seats facing the others. At night the lower berth is formed by the seat back; the other berth is

stationary, its bottom well above the height of a tall man; between these is the new intermediate berth, which is raised against the upper during the day. Each berth has individual curtains, shelf and hammock for belongings, and a ladder allows easy access to the higher berths. The Pullman coach-sleepers, only two of which have thus far been completed, are air conditioned and every berth has a fresh-air inlet individually controlled. The modern lighting system includes a reading lamp in each berth.

Garden Label in a Glass Tube Is Unaffected by Weather



To help identify plants, an outdoor garden label enclosed in a glass tube provides an easily readable marker unaffected by weather. The gardener prints the name of his plant on the paper insert, rolls it up and places it in the tube which then is sealed with corks at both ends. A metal supporting rod is pushed through one of the corks until the end is embedded in the other cork, leaving three inches extending outside for sticking into the ground or bending into shape to hang on bush or tree.

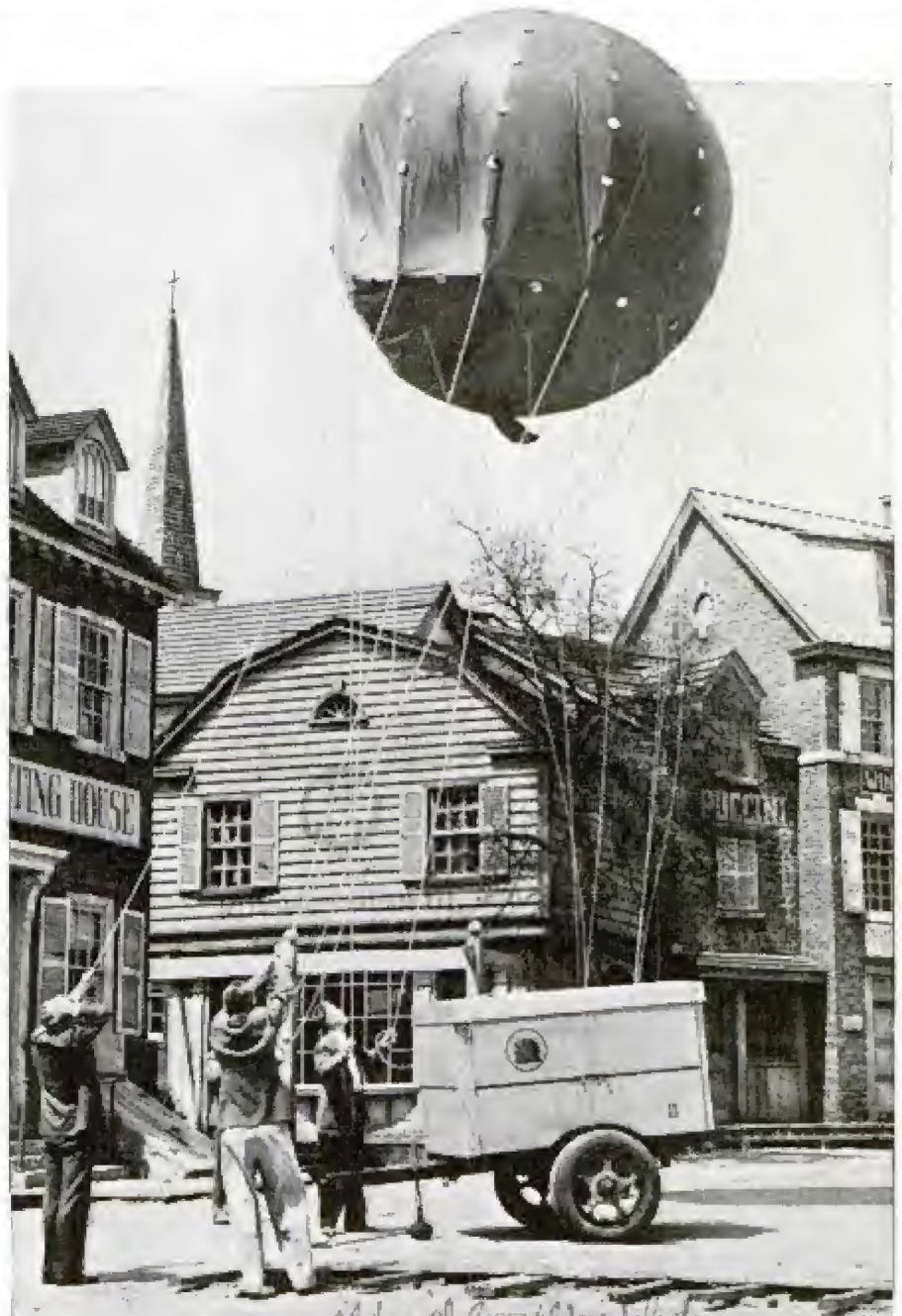
Glass tube sealed at both ends with corks keeps water from damaging the garden label

Balloon Guards Movie from Airplane Noises

Airplane pilots give a wide berth to a movie studio above which floats an orange-colored balloon, studded with silver reflectors, because in their language it means "quiet, please." Sound in the wrong places ruins a talking picture sequence, and the unexpected roar of airplanes has caused losses of \$250,000 to \$500,000 annually. The captive-balloon idea was agreed upon between the film and aviation industries as a solution to the problem, and it is used whenever a picture is being "shot," either on special outdoor locations or at the studio, to establish a zone of quiet warning pilots not to fly within three miles of the set.

Sending up captive balloon at movie studio as warning to pilots that talking picture is in the making. As unwanted airplane noise would spoil the movie sound effect, aviators steer a course at least three miles distant from any point where the balloon is floating

11566



Wide World

Offset Ratchet Screwdriver for Work in Close Quarters

Yonker 509



For driving screws in close quarters there is an offset ratchet screwdriver that will reach into narrow slots and similar places difficult of access. There is a fixed blade at one end and two ratchet-operated blades at the other end, the ratchet being reversible. Made of tough steel, these tools are offered in various sizes and with interchangeable adapters for use on the various types of screws.

Smaller than your finger, the ratchet-type screwdrivers at left have adapters for use with various types of screw heads

North Carol. Mfg Co
Pine Forest, S.C.

K519 FLOATING WALL of

RUMANIA has girded herself, like a medieval castle, with a vast moat stretching for 750 miles along its northern and western borders which, at the moment of invasion, can be turned into a river of flaming oil. For more than a year 150,000 Rumanians worked to construct the system of canals, locks to regulate the flow of water at various points, storage tanks for oil, and valves from which the oil can be released on the surface of the water and set ablaze, raising a wall of fire between the defenders and the invaders. There are three main sections of the moat, the longest running about 400 miles from Hotin on the River Dniester to Cetatea Alba on the Black Sea. The canals are fifty feet wide and twelve feet deep, connected with the Dniester and three of its tributaries to use their water and to form a continuous channel to the sea. This section divides the Rumanian province of Bessarabia from

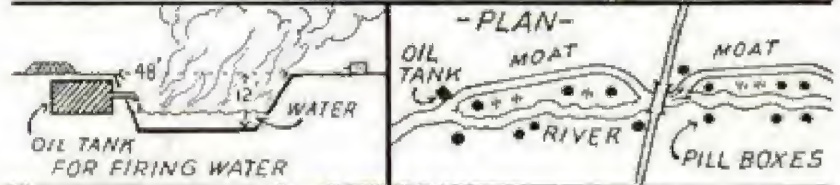
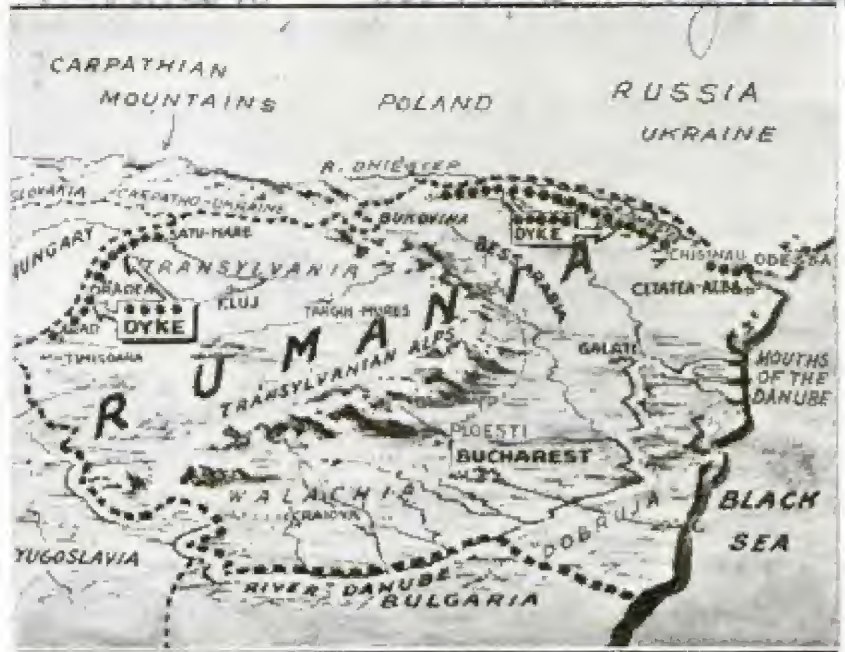
Soviet Russia. A second section runs from Hotin to Vijnita, connecting the Dniester and the River Prut, about 100 miles long. This part forms a barrier against what formerly was Polish territory, at a point from which either Germany or Soviet Russia might strike south into Rumania. Western Rumania is guarded naturally by the Carpathian mountains, but south of them the moat resumes in a 250-mile series of canals along the Hungarian frontier from Satu-Mare to Arad, using the waters of the Szamos, Crisul and Maros rivers. In addition to the moat of fire, the outbreak of war would be a signal for closing the steel gates which form tank barriers at the highways from Hungary into Rumania. Back of the canal system are trenches, fortifications and "pill boxes" connected with underground corridors. One section of the canal system was tested not long ago in a realistic rehearsal of a large-scale invasion at



FIRE GUARDS NATION

the Hungarian frontier. Crude oil was turned into the moat and set ablaze, while the fortifications were pounded heavily with artillery. The defenses fulfilled the expectations of the military experts. One especial advantage of the use of oil is that it freezes at much lower temperature than water and therefore could be used in the moat even during rigorous winters characteristic of southeastern Europe.

Right, map and plans of the flaming-oil moat. Below, across the pages, a battle scene with section of moat set afire as invaders storm the border



Mobile Cabinet and Bench Wired for Light and Tools.



Drawers in top part of portable chest hold socket wrench set. Note electric outlets at base of lamp

For convenience of mechanics, a wrench set consisting of fifty-three pieces is furnished in an easily portable cabinet that may be used as a worktable. Equipped with electric outlets and a built-in light, the cabinet has a roomy compartment at the bottom for bulky tools such as electric drills. A special feature of the socket wrenches is a "lock-on" patent which prevents sockets from falling off the handle.

Panorama Mirrors for the Car Show Side and Rear Views

Dual mirrors above the windshield offer the motorist an additional safety factor



The small mirror is flat; the broad convex mirror gives full view of sides and rear

through a panorama view of the road to both sides and the rear. The upper mirror is flat, giving the best judgment of distance. The lower one is a sixteen-inch convex mirror reflecting a wide panorama.

Portable Miniature Enlarger Packs in a Small Case

With the compactness of the miniature camera itself, a portable enlarger for miniature films dismantles and packs in a convenient carrying case only thirteen and one-half inches square and six and one-half inches wide. There are only two assembling screws, no tools being required, and the enlarger thus can be set up in a few minutes. Enlargements from two and one-half to nine diameters can be project-



Inset shows how the enlarger packs in a small carrying case which also holds developing material

ed on its baseboard, which packs away in the lid of the case; greater dimensions can be obtained by projecting against the floor or wall, the enlarger head rotating ninety degrees to right or left for projecting against a vertical surface. The case has ample room for a camera, developing tank, chemicals and other essentials.

Send stamped, addressed envelope to our Bureau of Information for name of maker of any device described in this magazine.

SEA GIANTS *on* PARADE

Marine Land
400-pound turtle being fed by hand
beneath the surface in Marine
Studios. Note wire "dinner pail"
which diver carries.

St. Augustine, Fla.





Attendants giving 250-pound green turtle its spring cleaning (above), and visitors watching the fish through some of the 200 portholes (left). Only still pictures may be taken by visitors.

By Julian P. Leggett

CAN fish communicate with each other? If so, how? Can a shark bite without turning over? Is it true that a porpoise will push the body of a drowned person ashore? How long may a porpoise, which breathes air like land animals, stay under water without drowning?

Scientists know the answers to innumerable questions like these, entailing long, patient study of marine life as it

exists in the open sea, because an outpost at which they may carefully observe and photograph the private lives of fish, both large and small, has been established. Two hundred glass portholes in the sides and bottom of two huge tanks comprising this outpost—the Marine Studios on Florida's east coast—permit scientist or layman to watch sea giants living a normal existence—feeding, courting, mating, reproducing and even playing tricks on each other.

Different from all other forms of the aquarium, because here marine life is not segregated in small tanks but is placed together, the studios are literally a cross section of the ocean, a constantly changing picture—gaily colored little tropical

W. Donald Burden, President.

St. Augustine, Fla.



1-19 K351
 fish scurrying into hiding from predatory enemies perhaps weighing hundreds of pounds, playful porpoises rising to the surface to expel and take in air through curious blowholes on top of their heads, a 1,000-pound sea cow nursing a 300-pound "youngster," a twelve-foot shark ignoring a school of silvery bumper fish, clumsy 300-pound turtles lumbering lazily along, huge rays flapping their way past a 400-pound jewfish standing guard over its "home."

Into this wonderland, housed in a circular tank seventy-five feet in diameter and a rectangular tank 100 feet long, scientists and staff members of the studios already have peered and emerged with the answers to several interesting ques-

Diver feeding porpoises by hand eighteen feet below surface (above). Interior view of rectangular tank (below) with attendants at work. The two tanks hold 800,000 gallons of sea water and 5,000,000 gallons are circulated by pump through the tanks every day. Note the observation portholes.





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Porpoise, almost with a smile, takes a mullet from the "table" floating on surface (above). Capture of a shark by fishing vessel's crew (bottom, left). Note trap door in stern through which specimens are taken aboard. Shark in well-stern of fishing craft (bottom, right) where anesthetic is administered which incapacitates the monster for two hours or longer, insuring safe transportation to Studios.

tions. Among other things, they have found:

That the porpoise communicates with another by a whistle emitted when air is ejected through the blow-hole on its head; that, contrary to popular belief, the shark can bite without turning over; that if a porpoise ever rolled a drowning victim ashore, it was simply because of the porpoise's playfulness and not because it was aware of any intentional accomplishment—in other words, the porpoise would do the same with any flotsam that might appeal to its curiosity; and that the porpoise, which can take in sufficient air to supply oxygen necessary for about two minutes of submergence, may prolong its stay under water because of an internal adjustment that provides for utilization of the oxygen mainly by tissues most sensitive to the lack of oxygen.

One of the first discoveries



at the Marine Studios, which has the only porpoises in captivity, was that the porpoise, which is a mammal, was capable of making sounds. During the first week or two of captivity all specimens whistled constantly and swam about the tank nervously. After they became accustomed to the tank, however, the whistling was heard less frequently and the sound apparently served as a method of communication. The porpoises seemed to use variations in the whistling to indicate different emotional states. Usually when one or several would chase a live fish, all would be whistling excitedly. When any disturbing object, such as a net, was present, this was true.

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Porpoise literally stands on end (right) to take a mullet. Big fish arriving at studios (bottom, left) in canvas hammock is deposited in tank by a boom. Releasing specimen (right) in receiving tank.

K. 351





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Once it was necessary to move a mother and a daughter porpoise from the rectangular tank into the circular one through a shallow connecting tank. The parent was netted and moved through the shallow connecting tank. The water level was then lowered in order to catch the youngster. The two remained in their respective tanks, close to the wire-mesh gates that separated them from each other, the young one whistling madly and the parent answering frequently. As soon as the water level in the two tanks dropped low enough, so the connecting tank was dry and the watery, and therefore sound-conducting, connection between the two tanks was severed, the parent left its position at the gate and swam about, even chasing live fish. The young one persistently whistled as loudly as ever, but the parent never whistled again after it was unable to hear the young one.

The shark, which has a bad reputation, doesn't always turn over to bite its prey, but only when it happens to approach from below—and that's the only position in which it can snap its ugly looking teeth on the prospective meal. In addition, the studios' staff has found that while the shark is extremely treacherous, it isn't as black as it is painted. Frequently the shark goes a week without feeding, never bothering other fish although many times some of the 50,000 specimens in the two tanks could be snapped up without effort. Attendants have noticed, too, that smaller fish seem to sense feeding time for the big fellow, scurrying for cover before he begins foraging. Sometimes, however, a shark breaks his fast unexpectedly, as one did not so long ago. Before attendants could do anything to save the victim, the shark had snapped up a spotted ray about five feet long. One reason for



Porpoise picking dainty morsel off bottom (top); a big turtle comes close to porthole to scrutinize cameraman (center), and diver using vacuum cleaner on tank bottom. One of the hardest problems the builders encountered was that of filtering the water sufficiently to remove debris without also taking out tiny animals and plants necessary to feed some specimens.

1K 35/
the shark's decorous behavior probably springs from the fact that all the fish are kept well fed, thus lessening the inclination, and necessity, for gobbling up the other fellow.

Satisfying the hunger of the studios' big family is no small job, either, because an adult porpoise consumes twenty pounds of mullet per day and others of the larger species eat proportionate amounts; thus it is no surprise to learn that the management keeps 50,000 pounds of mullet, frozen in blocks of ice, and 25,000 pounds of shrimp in the Marineland "pantry." A diver, who descends into the tanks frequently, plays the role of waiter, feeding mullet by hand to some of the big fellows, such as the porpoises, jewfish and the huge turtles. The diver carries the mullet in a wire-mesh "dinner pail," and, in case one of the sharks should become an uninvited guest at the party, he also carries a circular wire shield to protect himself. That didn't prevent a shark ripping the trouser leg off the diver upon one occasion, however.

An old tale about porpoises purposely helping to bring a drowned person ashore was exploded at the studios, as well as in Virginia Capes waters where photographs were obtained of two porpoises working for dear life pushing a water-soaked ship's mattress a quarter of a mile from deep water to the beach. It is not unusual at the studios to see a 400-pound porpoise playing a practical joke on the other specimens, such as rooting a 200-pound turtle from its place among the rocks and shoving it up and down the length of the tank. A porpoise will amuse itself for long periods by playing

Maneuvering a big fellow into well-stern of fishing boat (top); air view of Marine Studios with the Atlantic surf visible at upper left (center), and diver feeding a porpoise (bottom). In aerial photo, note the rectangular tank and the circular tank, separated by receiving tank in which specimens remain until found healthy.





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184.
Remarkable photo of 500-pound jewfish and diver (above).
Closeup of seven-ton coral reef in one of the tanks (below).
Note the octopus in foreground. Small fish seek protection
from enemies in this giant reef.



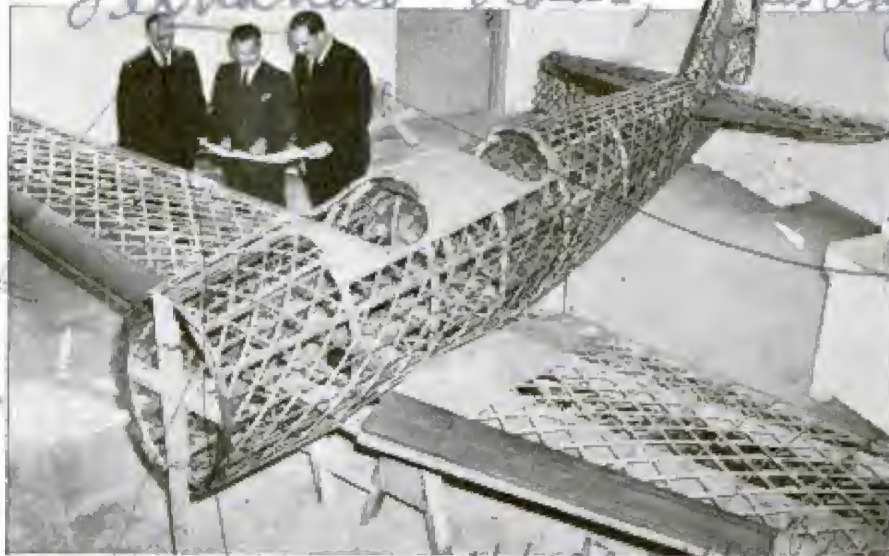
with large rubber balls, carrying a ball to the bottom in its mouth, releasing it and racing the ball to the surface.

It requires only two weeks to tame a porpoise so that it will accept food from the hand of attendants. If the food is held above the water, the porpoise will leap higher and higher, occasionally clearing the surface with its tail. It does not take a running start for a leap; instead it starts from the surface and drives itself steadily upward with powerful sweeps of the tail, enabling it to maintain a vertical position, standing on its tail, for several seconds.

Professor Laurence Irving of Swarthmore College is among scientists who have visited the studios to study denizens of the tanks.
(Continued to page 128A)

Airplane Fuselage Woven of Plywood Strips

Thin strips of plywood woven like a basket form the fuselage of a small airplane which may be the forerunner of a line of low-cost aircraft. The wood built into this two-seat monoplane cost exactly \$23. Materials for the jigs and forms cost \$10.20. Each plywood strip stresses the other until every inch of the fuselage and wing offers full cantilever construction. Wooden planes are more easily designed and built, there is more wood than metal available, and weight for weight, wooden ships provide a stiffer wing and smoother surface for aircraft up to 60,000 pounds gross, the in-



Here is the basket-weave airplane, woven of plywood strips; the wood in the plane cost twenty-three dollars. Any woodworker could build it

inventor asserts. Further, the labor market is unlimited since any woodworker could be taught to build plywood planes.

U. S. S. 'Indianapolis' Model Built to Scale by Craftsman



While the cruiser U.S.S. "Indianapolis" was at anchor with the fleet in Los Angeles harbor, Claude A. Lehman completed a model of the ship on a scale of three-sixteenths of an inch to the foot. An instructor in metal arts at Long Beach, Calif., Mr. Lehman has constructed as a hobby many miniatures of the United States Navy's fighting ships.

Ship model builder's latest achievement, a scale miniature of the cruiser "Indianapolis"

Screwdriver Has Replaceable Bits to Fit Screws of Five Different Sizes

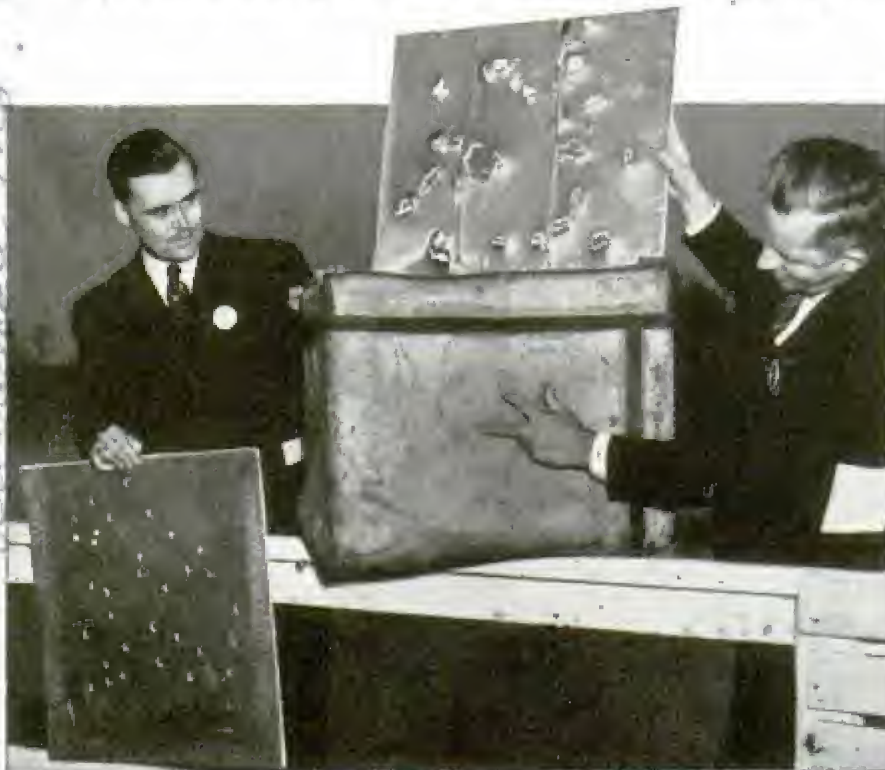
Screwdriver bits of five different sizes fit into a tool holder developed for the home or shop worker. Since the bits are replaceable, the tool is especially valuable for driving casehardened screws where there is considerable wear on the driver.



Fitting a new screwdriver bit into standard holder

Send stamped, addressed envelope to our Bureau of Information for name of maker of any device described in this magazine.

'Self-Healing' Gasoline Tank Seals Holes Made by Bullets



Examining bullet-pierced aluminum alloy shielding and the self-sealing gasoline tank which lost little gas when fired on thirty-two times

Able to seal itself when punctured, a gasoline tank intended for war airplanes automatically stops gasoline leaks through bullet holes. In a recent test the self-sealing tank, filled with forty-four gallons of gasoline, remained tight and lost very little gas after being penetrated thirty-two times by thirty-caliber armor-piercing bullets fired into the tank, although gaping holes were riddled in its aluminum alloy shielding.

Universe You See Is Flat with Shape of a Watch

Virtually all the stars visible to the unaided eye are spread out in a space shaped somewhat like a huge watch, having a diameter of about 50,000 light-years and being about 10,000 light-years thick, according to Better Vision Institute. It is pointed out that this watch-like shape of the visible universe is what makes stars in the Milky Way appear closely packed together, since we are looking at that region edgewise toward the remotest stars in the group. Reaching beyond this immediate system of stars, telescopes

observe more than ninety globular clusters, each comprised of about 100,000 stars, and located 100,000 or more light-years distant. Still farther out in space are thousands of spiral nebulae, some being 150,000,000 light-years away, which means that the beam of light striking the earth today started on its journey 150,000,000 years ago.

Giant Bomber Tires Carry Weight of Seventy Tons

Taller than many light planes, pneumatic tires, built for a seventy-ton bomber, stand ninety-six inches high. Two such tires form part of the tri-cycle landing gear, each taking its share of the landing impact and starting to rotate instantly on hitting the ground at 100 miles an hour or faster.



Eight-foot tire being examined by William Broughton, of Barcherton, O., whose model airplane won national racing honors

Expanding Tube Breaks Coal from Vein Safely

Much of the hazard of coal mining is removed by a new hydraulic mining process that applies a "squeeze play" to the coal vein. An expansible tube is placed in a hole drilled in the wall of the mine; an electrically driven hydraulic pump forces a low-inflammable oil through a hose into the tube, and its expansion under pressure breaks the coal along its natural parting lines. Around the tube is a cable braid that prevents expansion beyond a fixed maximum diameter. One of the principal advantages of this method, announced by E. I. du Pont de Nemours & Co., is its safe-



At right, miners insert the tube into hole drilled in wall of mine; left, hydraulic pressure expands tube and will shortly break coal loose along natural lines of cleavage. Cable braid around tube prevents over-expansion

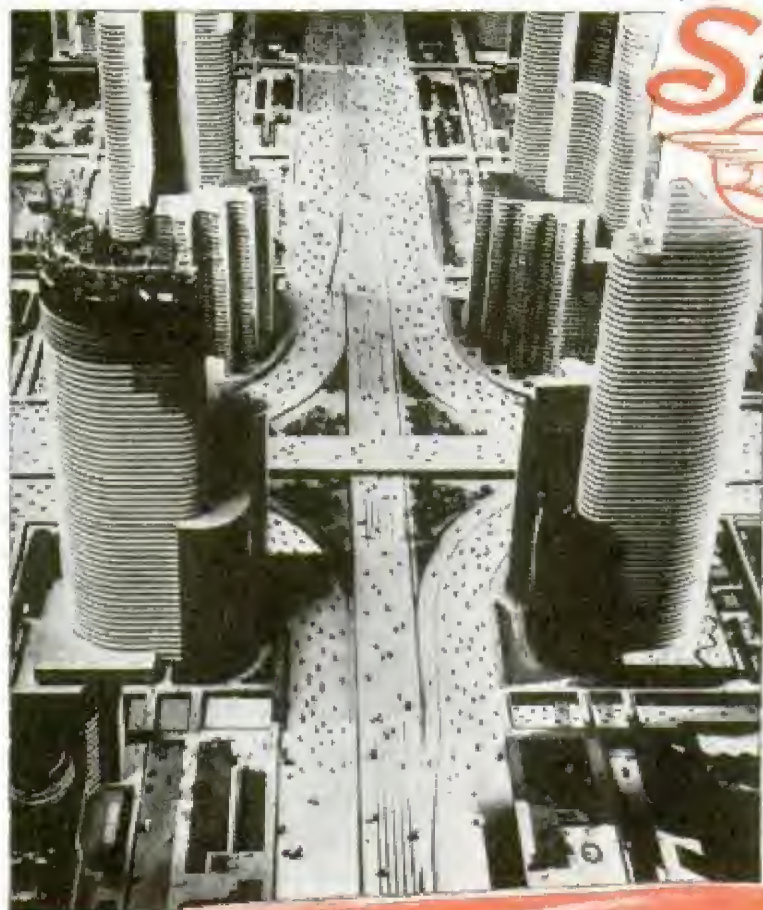
ty. There is no flame or dangerous gas, and no explosives are used. There is no flying rock or coal. The danger of cave-ins is minimized, since the expansion tube has practically no effect on the mine roof. Another advantage is the large percentage of big lumps of coal produced by the expansion method, a feature desirable to the coal industry. The tubes, five inches in diam-

eter and three to seven feet long, break the coal loose within thirty to forty-five seconds after being put in position.

Gasoline tax revenues of the forty-eight states reached a record of \$816,433,000 in 1939, topped by New York's \$69,693,000, Pennsylvania's \$59,584,000, Ohio's \$50,466,000 and California's \$49,795,000.

120 3 3 4 14, New York

Super-Speed

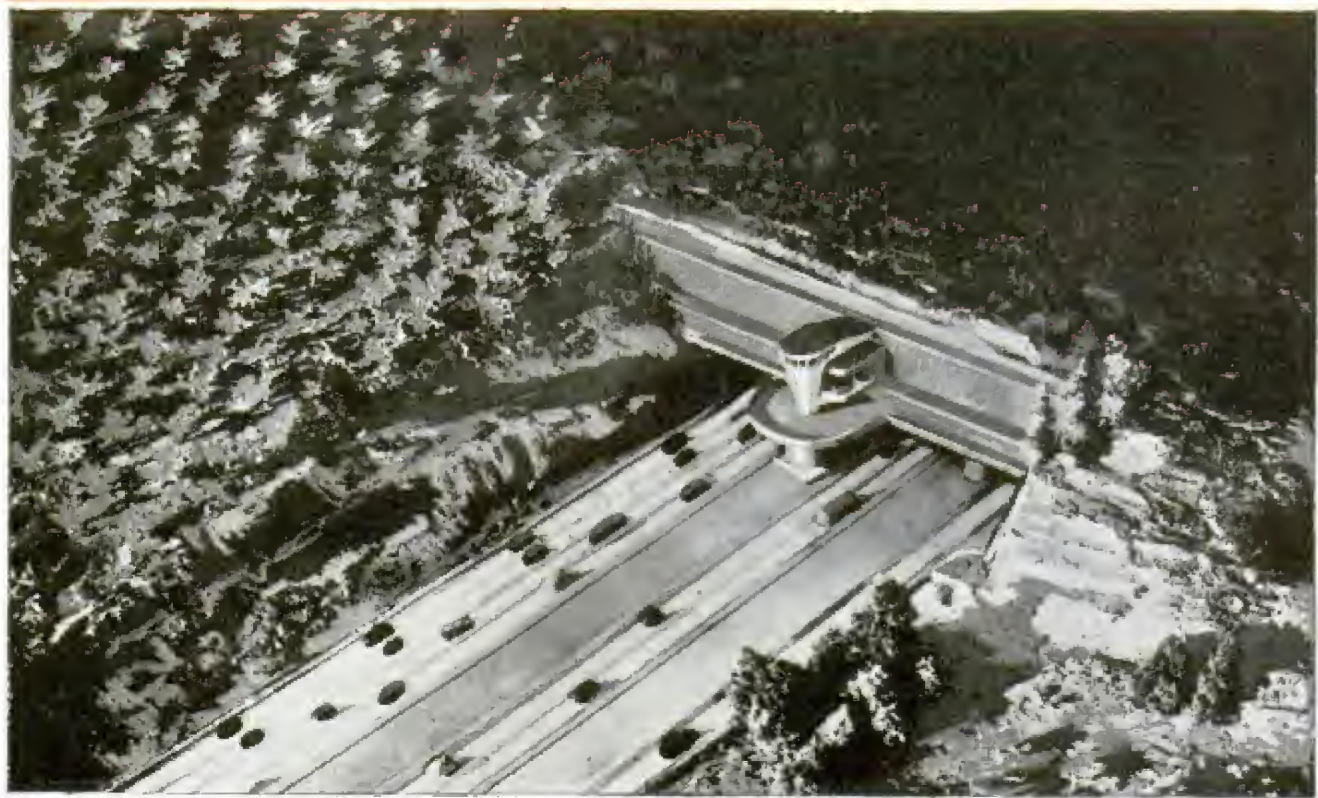


IT IS 4:15 o'clock on the afternoon of a pleasant June day in 1960. You, the wife and the children in your modest home on the outskirts of Washington, D. C., are planning to drive over for a day with Aunt Lillian in San Francisco.

You promised Aunt Lillian over the short-wave telephone that you would surely drop in for supper tomorrow night and it was good to see the happy smile on her face as she talked across the states.

With more than twenty-four hours to span the continent in 1960 at the wheel of your little old teardrop model, aluminum-alloy sedan you shouldn't be late, in the

Future highway pictures and sketches copyrighted 1940 by Norman Bel Geddes; photographs by Richard Garrison



Boulevards in the air (top), with no meeting of cross traffic or pedestrians, would permit fifty-miles-an-hour driving in heart of cities. Center, the teardrop car of 1960. Below, future transcontinental motorway enters mountain tunnel, with fifty, seventy-five and hundred-miles-an-hour lanes shown left to right

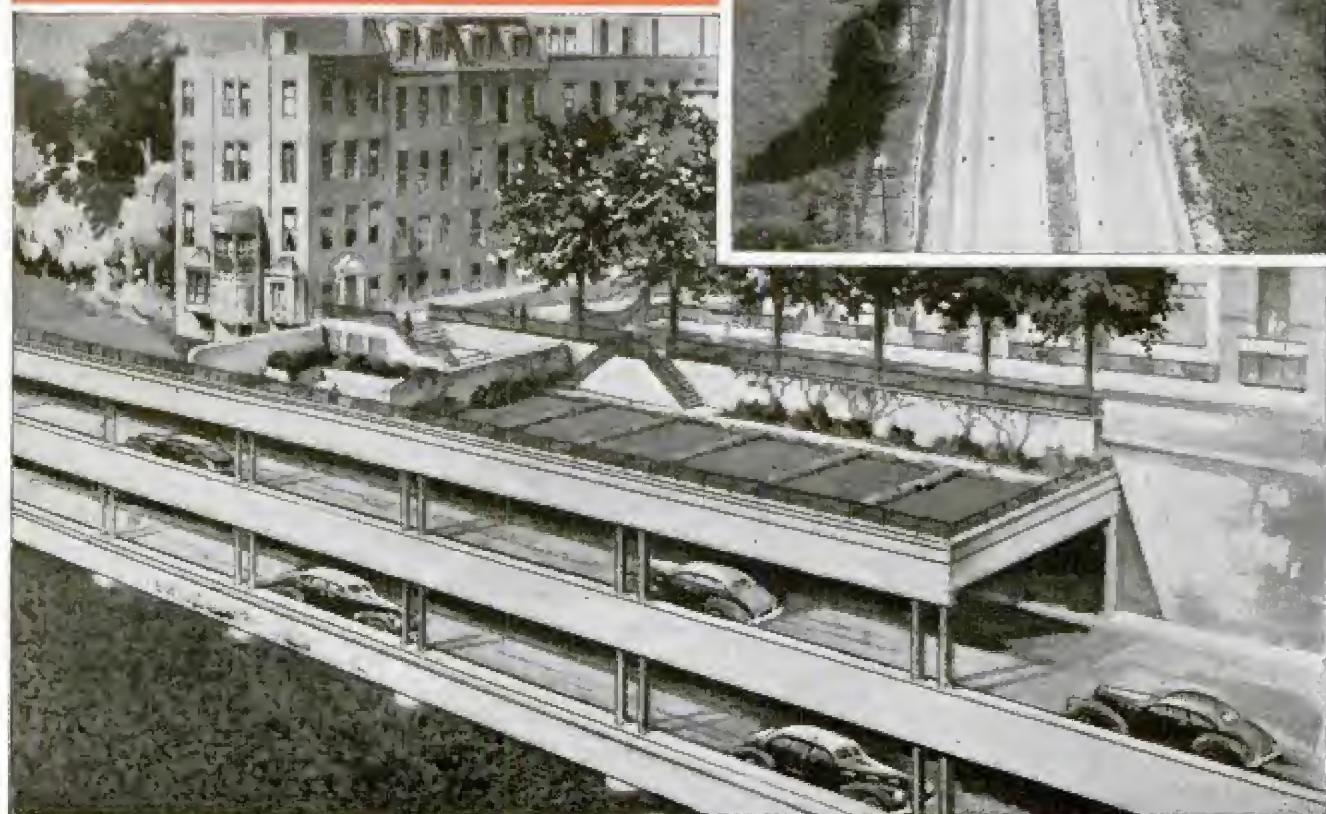
ROADS of TOMORROW

50 Rockefeller Plaza, New York

opinion of Norman Bel Geddes, noted industrial designer and author of the book "Magic Motorways." Not if progress in highway improvement and traffic control keeps pace with the possibilities science has already envisioned.

Designing the huge General Motors Futurama traffic spectacle at the New York World's Fair, with the cooperation of scientists, highway engineers and research men from the laboratories of leading automobile companies, necessitated several years of study by Geddes into the past, present and future of automobile traffic. Boiling the mass of information down, he asserts, it is likely that by 1960—a date set arbitrarily—100 miles an hour will seem no faster than the motor speeds we now take for granted. And travel certainly will be much more safe and comfortable.

So, with the help of Designer Geddes' research, you are able to pick up the story of what is likely to come—subject to modifica-



New Jersey State Highway Route 26
Barnum Pike. Princeton. New Jersey

Top, transparent plastic control bridges at five-mile intervals would automatically control your motor and speed by short-wave beams. Two-lane New Jersey highway, center, runs twenty-seven miles in almost straight line. Bottom, two-deck East River Drive in Manhattan is to have third deck landscaped



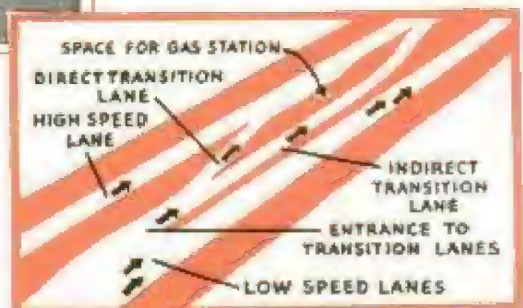
This beam control is simple, but important; it will regulate the velocity of your car, guide you into the traffic lane corresponding to your desired speed and keep a margin of safety between your automobile and those in front or behind all the way to California.

The family climbs in, the motor at the rear is running sweetly, and in a few minutes you are off for the motorway feeder lanes. As you bear to the

tion by developments which cannot be foreseen—and drive across the United States at a speed which leaves you breathless in contemplation right now.

While the wife and children are gathering up the few things they need for the trip, you go downstairs to the garage. The old bus is a bit dirty around the vertical fin and the right rear tail-plane surface has a small dent, but that won't matter. You examine the eight tires which have become necessary on these no-chassis models because loss of weight has reduced traction. You inspect the Diesel-electric power plant. All okay.

Now you climb into the centrally located driving seat, flick over the air-conditioning key and switch on and off the automatic beam control for a test.



Above, scheme for transition from one speed lane to another. Below, uniform surface illumination from center curb



Top, traffic circle at Camden airport. Bottom, complex traffic distribution system west of George Washington bridge; note three-level crossing

right from the secondary highway at the transcontinental motorway feeder point and enter the feeder lane, you switch on the beam device and feel the automatic car control take effect. Approaching the motorway on a long, sweeping curve, the car automatically accelerates to a steady fifty miles an hour, ready to merge with the flow of traffic on the through lane.

For a moment you parallel the motorway on the feeder lane and then au-

tomatically slip into a gap in the spaced line of cars heading west. You are lucky to find a vacant space, or the speed control would have stopped you in response to the beams emanating from the transparent plastic control bridges you are continually passing under.

As darkness falls, you wonder how folks ever managed to drive, back in 1940, blinded by stabbing lamps. Ahead the motor-



way is bathed with an even glow of light from a continuous tubular fixture raised slightly above the roadway center. A banner of illumination extends for a distance in front of your car, lighted by an electric-eye device and extinguished behind you in the same manner, so that the road is lighted only when it is being used. There is no glare; no unsightly poles or distracting flashes of light as you pass.

Your control device broadcast tells you that you are whizzing through the Blue Ridge mountains. On the left, beyond a plot of grass is the 75-mile-an-hour

(Continued to page 138A)



Top, junction of two major arteries in the future. At left, modern divided highway in New York is jammed because of cars turning left in front of heavy traffic at grade intersection. Below, each traffic lane, divided according to speed, has a separate approach and deck on suspension bridge of the future

Small Wheel within Wheel Eases Maneuvering of Car

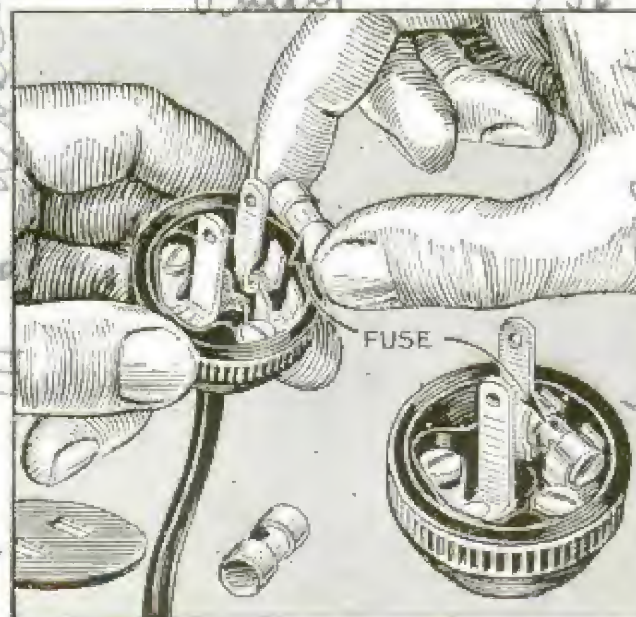


Small wheel at top of steering wheel offers an easy grip when turning sharp corners or parking the car

Parking your car and maneuvering in traffic are made easier by a new wheel within a wheel. Turning freely on its ball-bearing mount within the steering wheel proper, the small wheel offers a convenient hand grip for swinging the car around corners or backing into the curb.

Safety Fuse in Electric Wall Plug Guards House Lights

Embedded in an electric wall plug now available is a tiny fuse that will keep your lights from going out when a defective lamp cord or appliance short-circuits. The



Tiny fuse inserted in wall plug at contact point prevents short circuit from overloading main fuse

little safeguard burns out before the main fuse becomes overloaded, saving you a trip to the basement or attic to replace it. The fuse is held in the plug by two clips.

Lie-Awake Detector Tells You How You Tossed Last Night

Those who believe they do not sleep a wink all night can learn exactly how restless they are with an instrument the inventor calls a motilograph, popularly known as a lie-awake detector. A leg of the bed is fitted into a stirrup which transmits to the recording part of the apparatus every movement made by the sleeper. Next morning he will know how much tossing he did during the night and, on the other hand, what part of the night was spent in sound sleep. The average sleeper, the inventor has found, changes position from twenty to sixty times a night. The first half of the night is usually quieter than the last half, although there is a pre-sleep period of settling down, with a fair degree of restlessness, which lasts from a few minutes to a half hour.

Double Bucket for Anglerworms Keeps Them Alive and Active

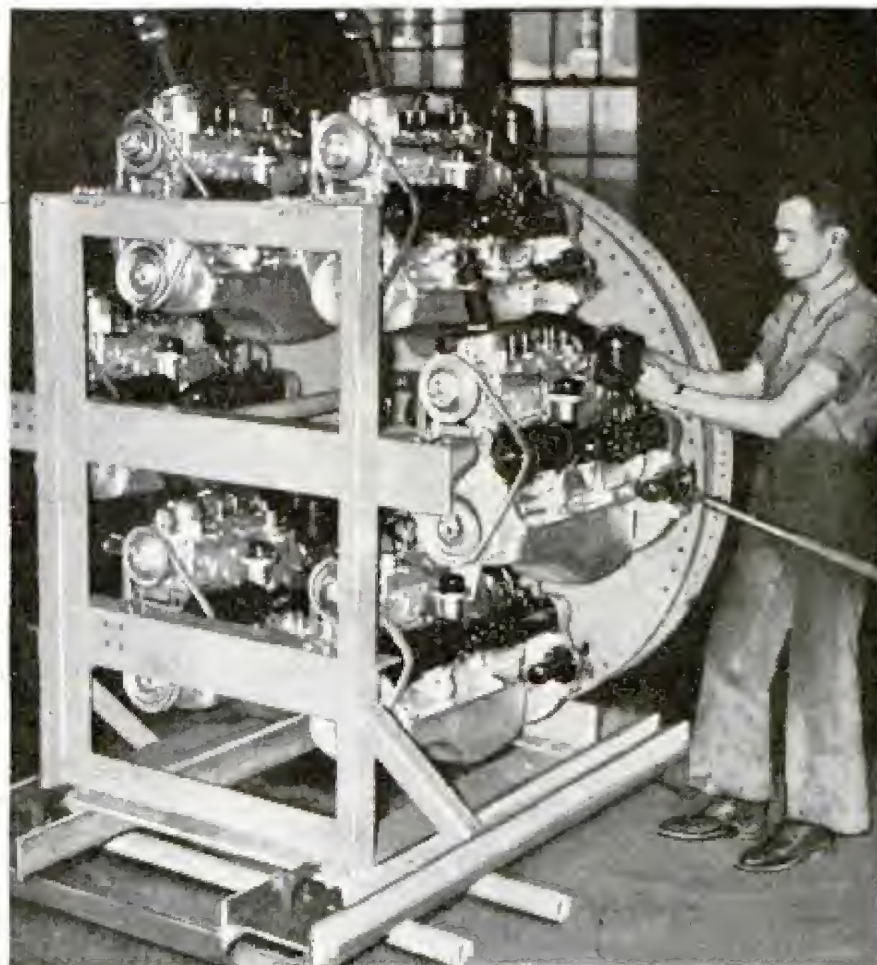


Worm can immersed in cold-water jacket keeps life in the wrigglers by condensing moisture within can

Built like a double boiler but serving as a cooler, a fisherman's bucket keeps worms lively over a long period. The worm container is built into a large bucket, or water jacket, that is kept filled with cold water. This causes condensation inside the worm container, bringing in fresh supplies of oxygen and producing moisture.

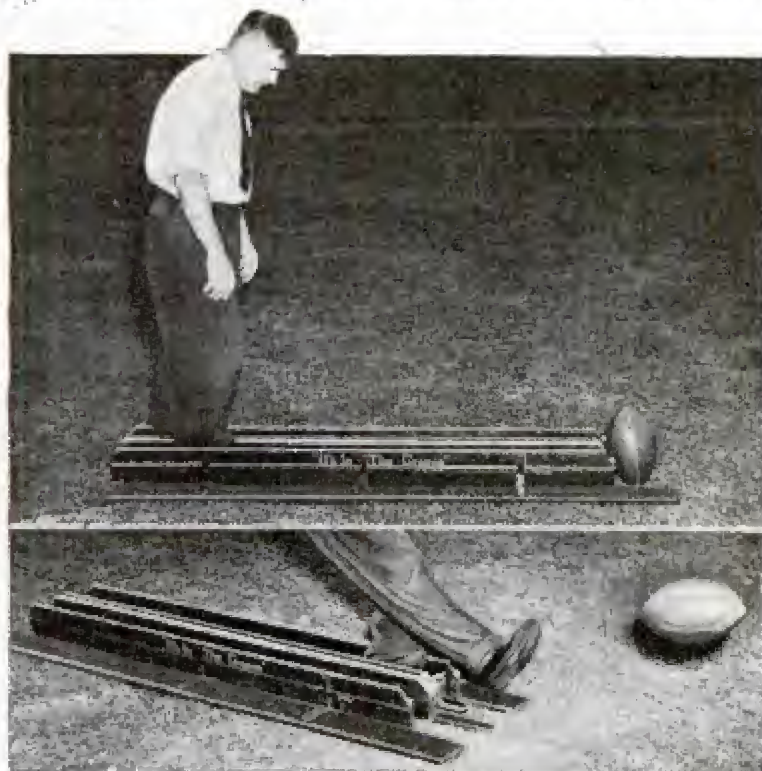
Six Auto Engines Team as Single Power Plant

By harnessing six automobile engines as a radial unit driving an eccentric central shaft, engineers in the machine shop of the University of Kentucky have produced a multiple power unit at a cost of about \$1,500, with the efficiency of an engine selling for \$12,000. Six Plymouth motors were used, their collective horsepower being transmitted to the central shaft by means of a "spider." The six crankshafts extend to the inner side of a plate to which the engines are fastened, and are connected by the spider. At 3,600 revolutions per minute each motor produced eighty horsepower, but to reduce wear the speed was cut to 1,800 and horsepower thus to forty. With all motors working, the plant has 240 horsepower.



Six automobile engines fastened to a plate pool their horsepower in a central eccentric drive shaft, thus forming a multiple radial engine

Football Players Practice Kicking in Grooved Runway



Keeping both feet in grooves, football player runs forward in practice rack and kicks the ball, as shown in bottom picture

Football place kickers are improving their accuracy with the aid of a frame that forces them to abide by the old axiom, that they should kick as though their feet were in grooves. It consists of two grooves, one for each foot, teaching the player to step straight ahead and to time his steps so he will kick at the right moment and in the correct standing position. At the end of one groove a football is set at the desired angle for place kicking, and a block is used in the opposite groove as a stop for the other foot. The ball and the block may be placed in either channel to accommodate right or left-footed kickers. Inexperienced men have attained ninety per cent accuracy in actual play by training their feet to stay in the groove naturally.

WHY NOT

ARE you wearing yourself out doing things the wrong way?

On scores of everyday tasks, lugging trunks, sweeping the basement, shoveling snow, do you expend energy needlessly and fatigue your body out of proportion to the work you've done?

If you do, take a tip from Wallace Rosenbauer, noted sculptor, and acquaint yourself with the mechanics of the body, its functions as a weight-bearing, weight-lifting structure, and you won't waste so much time and energy doing simple jobs the hard way. A working knowledge of the engineering principles governing the human body is the key to conserving energy and eliminating muscular strains.

Were it possible, through the eyes of an engineer, to look beneath our skins, Rosenbauer explains, we'd see how inexpert

many of us are in handling this, the most functionally varied machine ever conceived. We would be able to see how a mechanical

Below, the hard way to move a trunk, its weight on knees hampering movement. Top, the professional way, started from kneeling position, one hand holding burlap strip. Lower left, easy way using back and leg muscles



TRY *the* EASY WAY?



Above (left), with load unbalanced the body must work harder; (right) movement is free and natural with heavy load properly balanced. Practice balance by putting on socks while standing (bottom). Diagram of foot shows how arch distributes weight

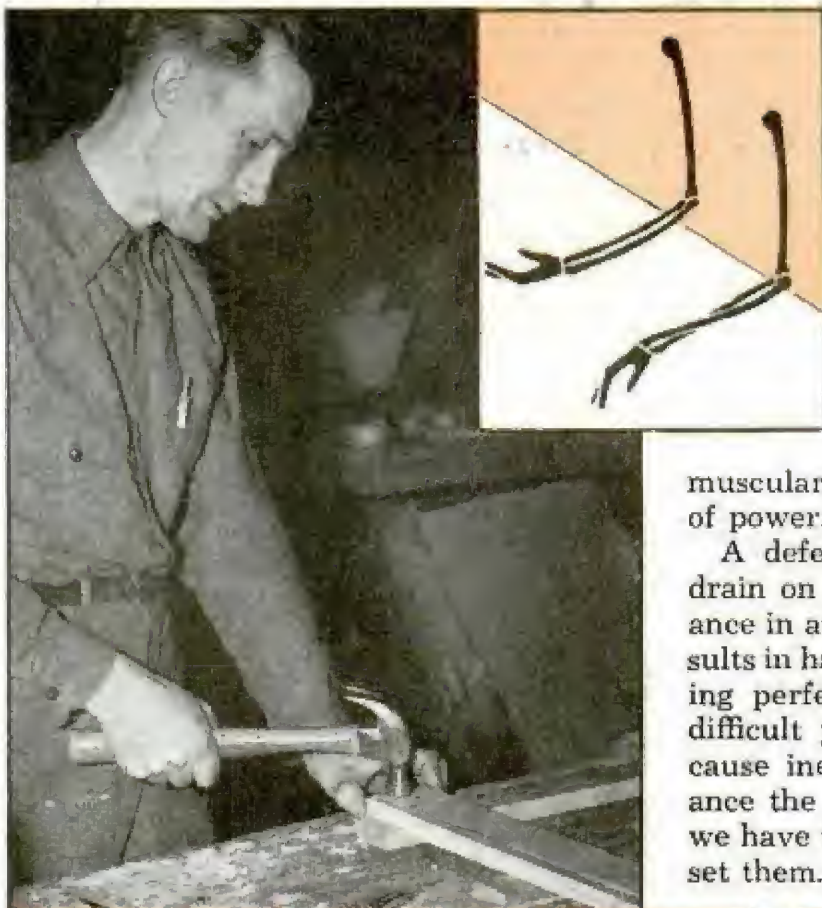
force operates on the body the same way it does on any other arrangement of weights, levers, and supports; how by slumping instead of sitting in a chair we tax our strength more than if we were walking, and how by using our arms instead of our backs in lifting a heavy object, we're sending a boy to do a man's work.

Getting out of balance is our chief difficulty, the anatomical authority says. The shop worker who miscues in hammering a nail is guilty of the same error as the golfer who slices his drive: he's out of balance, so the full impact of the blow hits at a point off dead center with lamentable results.

The most telling blow in a fight is the one a boxer gets across when he has his weight perfectly balanced. On the other hand, the shock from a hit made from an unbalanced position, as from the heels, shoots through the fighter's body at angles, whereas a properly delivered punch is continuous from fist to feet.

The reason Rosenbauer gives for this is that all

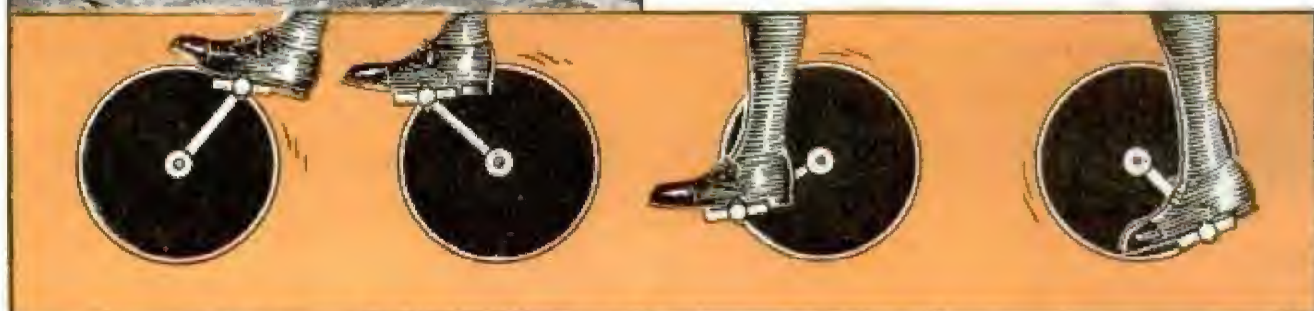




the bones and actions of the body are curved. "Your arm," he states, "if left to itself will assume a curved pattern from hand to shoulder even with the elbow flex. The design of the bones is such that there is a continuous curve directly through them. There's one position where that curve is best adapted to a given job and in any other position

there will be not only extra muscular tension but a corresponding loss of power."

A defective posture can be a constant drain on our energy because lack of balance in any structural part of the body results in habitually strained muscles. Standing perfectly still without straining is a difficult job, Rosenbauer points out, because inertia and gravity tend to unbalance the various weights of the body and we have to set up a counter tension to offset them. Strictly speaking, however, this



As in golf, the carpenter (top) must let body move easily; with body rigid (bottom) hammer is out of control. Drawing shows how curve of arm changes for leverage in lifting or setting down an object. Center, proper ankling is key to effortless pedaling



rigidity is unnatural to the body, for muscles cannot be held contracted for long without tiring.

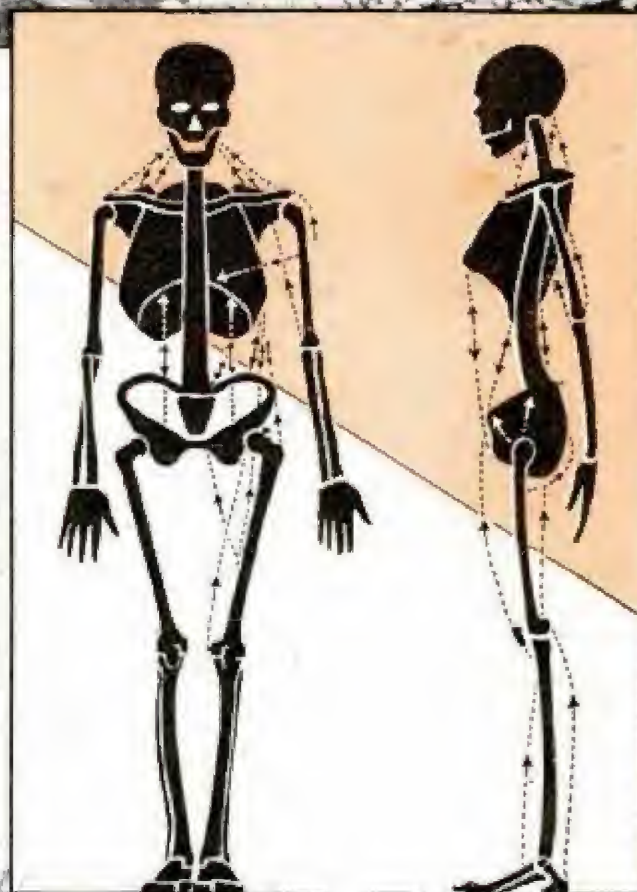
The human body is built on a slightly curved, upright column with accumulated load concentrated on a narrow base (pelvis), whence it is distributed through only two supports to the ground. The head, chest, and pelvis—the bone on which the spine rests—are the three heaviest weights and by standing incorrectly, carrying the head or chest in a manner not in keeping with the design of the body, these bony structures will be thrown out of balance at their joints, and the muscles must carry these weights off center, placing unnecessary strain on them. Muscles are for moving bones, not supporting body weights, which is the skeleton's job.



Shoveling with arms alone (above), straightening the back each time, tires the worker quickly. It's better to balance the body and use arms pendulum fashion (upper right). Diagram shows mechanical forces in body, lines representing the pull of muscles

Apart from resisting gravity and providing a framework for the body weights, bones serve as joints of leverage for the muscles. The sculptor likens a muscle to the spring on a screen door: It can only pull two ends together by contracting. When you crook your arm, for instance, here's what happens: the bicep, tied to the shoulder bone at one end and a tendon at the other, receives the impulse from the spinal cord via the nerve, and contracts. Contraction causes a pull on the tendon, which moves the bone in the forearm called the radius. To straighten the arm out, a second muscle, the tricep, gets the assignment. So it is with the two hundred other movable joints in the body; two or more muscles work at each of them.

"The body," Rosenbauer explains, "stays together and operates by opposing muscular tensions. From the front (or back) the body is bisymmetric on its vertical axis. The spine can curve slightly and the legs (with the feet) can rotate outward and bend at the knee and ankle, but the body is not well adapted to side movement without twisting, which brings the long curved forms of the side into play.



"From the side, the forms of the body are two long component equal curves, one for the legs, one for the torso. If you bear in mind the extreme flexibility of the smooth-working hinges and ball-and-socket joints by which the rigid forms of the body are joined, you realize the im-

(Continued to page 125A)

K 524

Four Lights for the Darkroom Provided in Single Fixture



To change colors of this darkroom light, boxlike insert slides out and is turned to another "window"

Four different lights for the photographic darkroom are provided in a safelight just brought out. Box-shaped, an insert which slides in and out of the lamp chamber has four unbreakable plastic filters; one red, one green, a third orange-green and the fourth shedding a diffused white light for examining negatives.

High-Speed Portrait of a Sneeze Stops Mile-a-Minute Spasm

If you've never "clocked" a sneeze, consider the report of a Massachusetts Insti-



This is how a sneeze appears to high-speed camera

Cambridge

tute of Technology scientist that it's a mile-a-minute spasm spraying minute droplets from the nose and mouth at "muzzle" velocities as high as 150 feet a second, or nearly two miles a minute. Prof. Marshall W. Jennison found this out by taking ultra-high speed photographs stopping a sneeze at its climax. The pictures showed thousands of droplets varying in size down to a diameter of 1/250 inch. Scientists are studying the responsibility of the sneeze in spreading germs of respiratory diseases.

Plastic Sun Shields for the Eyes Are Safe for Sport or Driving

Protection from glaring sun and bright lights is provided by eye shades, worn like glasses, which are made of lightweight and non-breakable Tenite plastic and contain no glass. They may be adjusted to shield the eyes against glare from any angle, the



Eyeshades made of plastic have up and down adjustment to shut out glare, yet permit desired vision

nosepiece being of soft rubber and comfortable to wear. Made in many attractive colors, they permit unrestricted vision and are particularly suitable for driving and participating in sports.

¶An artificial display of the colorful Aurora Borealis was produced at Hayden Planetarium in New York by shooting a 15,000-volt current through a four-foot glass tube from which most of the air had been withdrawn.

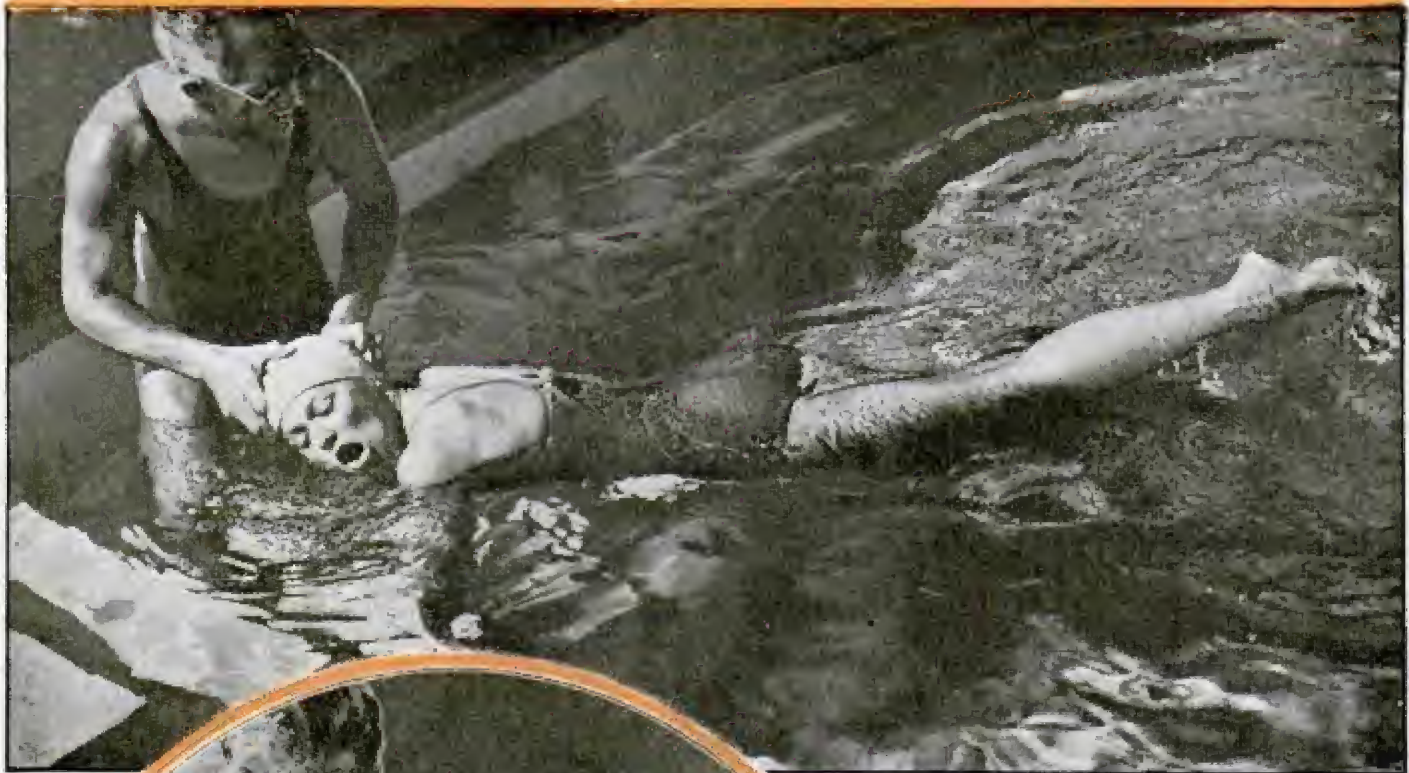
Flying Nurses "Bail Out" with First-Aid Kits



French flying nurses spend three months learning the art of parachute jumping and practicing folding and maintenance of parachutes. They are ready to fly to the scene of disaster, and drop with first-aid kits and medical supplies if no landing field is near by. Before the girls are allowed to make practice jumps from a parachute tower they are suspended from the ceiling of a parachute factory and trained in maintaining balance in the air.

Top, learning to release parachute after landing will save the flying nurse broken bones when the emergency comes. Below, indoor practice with the 'chute. The kit, carried on the nurse's back while descending, includes part of portable operating table

GET INTO THE



Top, Steve Forsyth teaching proper breathing, and timing it with the kick. At the left the coach starts a pupil out on the correct stroking of the crawl



By Steve Forsyth

Associate Olympics Swimming Coach

THERE is no excuse for being a poor swimmer. If you've tried in vain to become proficient, your failure probably is due to fear of the water or ignorance of how to breathe properly.

You could not swim the first time you

entered the water because you, unlike animals which swim with no difficulty on their first plunge, had an inherent fear of the water. And, although you may be able to paddle slowly in deep water, you still may be afraid. You must conquer that fear before you can become a good swimmer. One way to do that is to remain in shallow water and practice strokes and breathing until you gain complete confidence. With the increased poise and

ease will come relaxation of the muscles, which is one of the essentials in smooth, powerful swimming.

When you are ready for the next step, and I believe the most important one, toward proficiency, try this: turn your head to the left as you count one-two, at the same time taking a quick, deep breath through your mouth; then exhale through

*Flamingo Hotel Fla.
Medicine Beach Fla.*

K 314

*see Aug 1941 37
diving*

SWIM

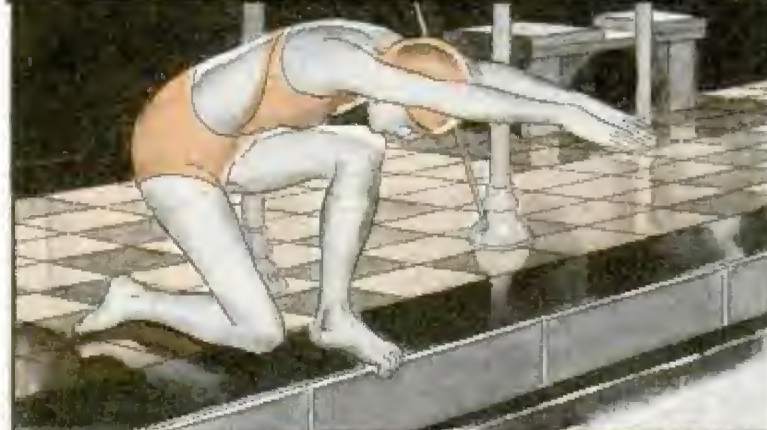


Above you see a champion in action—Adolph "Sonny" Kiefer, holder of a flock of back-stroke records. The sequence at the right illustrates the "butterfly" breast stroke, latest swimming development

your nose as your head returns to normal position, counting one-two-three-four with the same regularity as you used in timing the intake of air.

Sounds easy—and it is easy, out of the water. But try it in the pool and you'll find it is a little more difficult than it sounds. The deep breath is taken just as your head reaches a point where the mouth is clear of the water and is expelled with the face in the water, blowing bubbles. You have to use some force to get the air out of your lungs, thus contracting the muscles of your diaphragm and getting them ready to expand for taking the next deep breath. You can't do this exercise too much because you must learn to time your respirations so that you'll be able to breathe normally while swimming. And that's more difficult than learning the mechanics of a stroke. Even after you've become profi-





At top, Ralph Flanagan gives a demonstration of rhythmic breathing and the crawl stroke. At twenty-one Flanagan held more American swimming records than anyone else and he is one of the greatest stylists. The drawings show a simple way for beginners to dive, starting from a crouch on one knee

cient it is wise to continue the bubble blowing, practicing with several complete breaths before starting to swim.

When breathing is faulty the swimmer's muscles tighten up, due to accumulation of excessive carbon dioxide in the lungs, and the strokes are jerky. When normal breathing is resumed, the muscles relax and function at top efficiency, resulting in smooth, powerful stroking. Most swimmers do not utilize one-third of their lung capacity, and therefore their diaphragms, which might be called motors, do not function properly; every muscle is subjected to a harder pull, and endurance is minimized. That is why I maintain that proper breathing is the key to swimming.

Once you have developed lung capacity, and normal breathing comes easily in the water, you may go into your lessons, doing any one of several styles, perhaps the American crawl because it is easy to learn and is the most efficient and fastest of all styles. We learn the kick first, using an easy, free up-and-down motion of the legs from the hips, similar to swinging of a pendulum. The foot goes down about twelve inches and then back to the surface in a series of short, whiplash motions until you can make two complete kicks per second. One kick is the motion of one foot going down at the same time the other comes up. Next comes the arm stroke. Assume a position in waist-deep water, one foot forward and the other back, to brace the body and retain balance. Your right arm is placed in position, straight out in front of the right eye; the left beside your left side. Now you pull the right arm back through the water, at the same time raising the slightly crooked left arm out of the water and bringing it forward. Keep your head motionless, looking

down and slightly ahead. The right arm is pulled straight down and back under the center line of the body with the hand taking the lead and a slight bend in the elbow, as the left arm comes forward. When the right arm pull nears the surface the left arm enters the water in front of the left eye and begins the pull in a similar manner. At this point the shoulders should be virtually level, which is highly important. Practice until you can coordinate the pull and the recovery strokes with the shoulders.

Now try to swim, starting the kick and then the arm stroke and getting three kicks on each arm pull. Thus as the right foot comes down on the count of one, the pull begins and finishes on the third kick. The body should remain floating, head motionless, eyes open looking straight down at the bottom. The arms enter the water close to the head. After you've learned to combine the kick and arm stroke while holding your breath, you may try breathing. With the right arm straight ahead, the left to the rear, the head should be pivoted to the left on the one-two count, air being inhaled through the open mouth. If you find it easy to take the breath from the right side, simply have the left arm ahead and the right one back.

After the breath is taken in, the exhaling position is assumed, with face straight down in the water. The air is expelled evenly through the nose to the counts of one-two-three-four. Thus you have a complete respiration in six counts. Practice until you can exhale with ease at least twenty breaths in the water without stopping.

Now comes the important point of timing your breathing with the

(Continued to page 122A)

Here Ralph Flanagan—whom Forsyth began developing at the age of seven—demonstrates the American crawl arm stroke. One of his secrets is his manner of maintaining shoulder balance while continuing to breathe normally



Copy of Village Has Lights in the Tiny Homes



Builder turned his model village into a reproduction of his own neighborhood by constructing miniatures of his neighbors' homes and substituting them for the tiny houses originally used for the setting

Starting with tiny houses he purchased in the dime store, Russell L. Snyder, of Millburn, N. J., is rebuilding his neighborhood on a scale of three-fourths inch to one foot. As he completes models of his neighbors' homes, each is inserted in its rightful place and the "store" model is removed. Measuring eight by sixteen feet, the "town"

is given local color by trees and shrubbery made from sponges, streets with realistic lamps, policeman on the corner, and shoppers, mailman and delivery boy on the sidewalks and streets. From a waterfall with concealed pump, water flows to an old mill and turns a water wheel. At night the streets and midget houses are lighted.

Uniform Spreader for Fertilizer Is Useful Also as Seeder



Tractor-drawn fertilizer spreader may be used for sowing grass and clover

Fertilizer can be spread evenly, in amounts from twenty to 2,350 pounds per acre, with a distributor having the hopper at a convenient height for filling. The quantity to be scattered may be regulated while moving. The adjustments are accurate enough for sowing grain and clover seed. A force feed assures uniform spreading of fertilizers that become damp and sticky, and a special at-

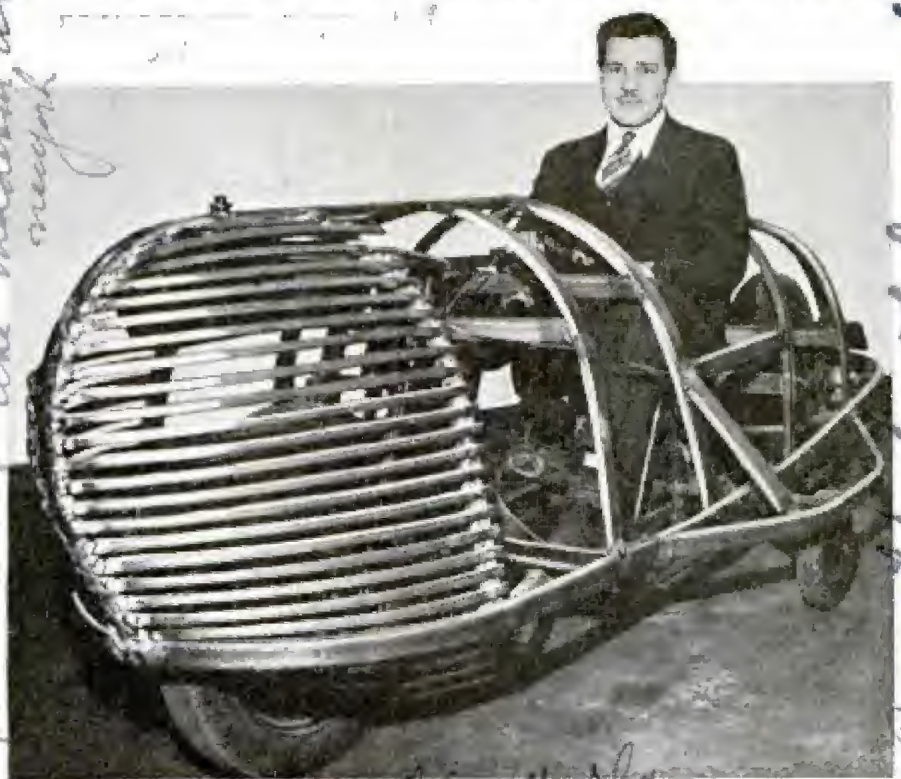
International Harvester Co. 180 N. Michigan Ave. Chicago, Ill. 39

tachment helps strew ammonium sulphate. For lime, the capacity is ten to 2,350 pounds to the acre. The implement is said to be especially suited for applying top dressings to pastures, meadows and orchards.

Life Span Gains Twenty Years Since 1870

Babies born in 1940 can expect to live to the age of sixty-two years. Life insurance company statistics show a steady lengthening of the life span in this country, due to the better standard of living and medical and sanitary advances. The babies of 1870 had a life expectancy of only forty-one and one-half years, according to mortality rates then prevailing, but even during their lives conditions improved to such an extent that the average person born in 1870 actually lived forty-six and one-half years.

Automobile's 'Missing Link' Is Four-Wheel Motorcycle



Strange vehicle on eight-foot wheelbase includes two retractable wheels to give balance when needed. The welded frame has room for driver only

What might be classed a link between a motorcycle and automobile is a vehicle consisting of a welded frame built on two motorcycle wheels and powered with a motorcycle engine. Having room for only the driver, the "quadracycle" includes two extra wheels mounted in outrigger fashion which may be retracted like airplane landing gear when not needed for balance. It travels at a forty-five mile clip.

Football Blocking Indicator Shows Work of Each Player



Each football player is represented by a figure in "blocking indicator"; green lights flash for those who get their man, red for those who do not

Blocking performance of each football player on the offensive side is indicated on an illuminated board after each play. The board was designed as an incentive for players to block more efficiently as well as to help spectators keep check on individual effort. Figures of eleven men are shown in team formation. If a player blocks his opponent successfully, a green light flashes on the board in his position; if he fails to get his man, the light is red.

BUILDING a



Buildings located in most of the principal cities of the world are represented in miniature in two cities made to order for the New York and San Francisco fairs. The dioramas show how widespread are the branches of a large manufacturing concern. They include 326 models built from photographs, sketches and blueprints of the company's buildings in various cities



Photos courtesy Diorama Corporation

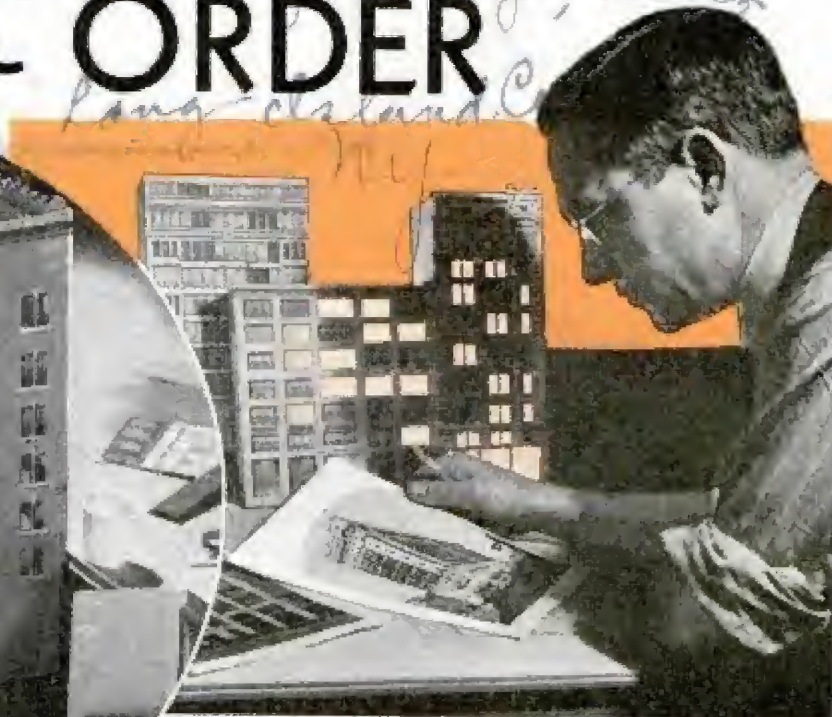
Top, left, when completed, each tiny structure was sprayed with paint and glue and then turned over to artists who performed the final painting and touching-up before it took its place in the setting; right, at

work in one corner of studio. Workman, center, is guided by photographs and topographical sketch as he assembles a country clubhouse. Lower left, steel wool is used in making trees; light trees are of swamp moss, and darker ones of rubber; note tree to right consists of twisted wire to form trunk, spreading out into branches. Variations in architectural style and size of buildings required careful planning to group them harmoniously

CITY to ORDER



Composition walls are glued to building frames made of wood, above; ordinary clothespins holding them together until glue sets. Below, a study in proportions; model builder, squatting near tiny street being built for another diorama, paints dwarf buildings that form part of city built to order. X-marks on windows protect glass from breakage



Right, top, three stages in constructing city include, first, photograph of building; second, sketch made on cardboard; third, completed likeness ready for painter. Bottom, Edward H. Burdick, creator of city built to order, shows how models are built out-of-plumb to blend into tricky perspective of scene when in place

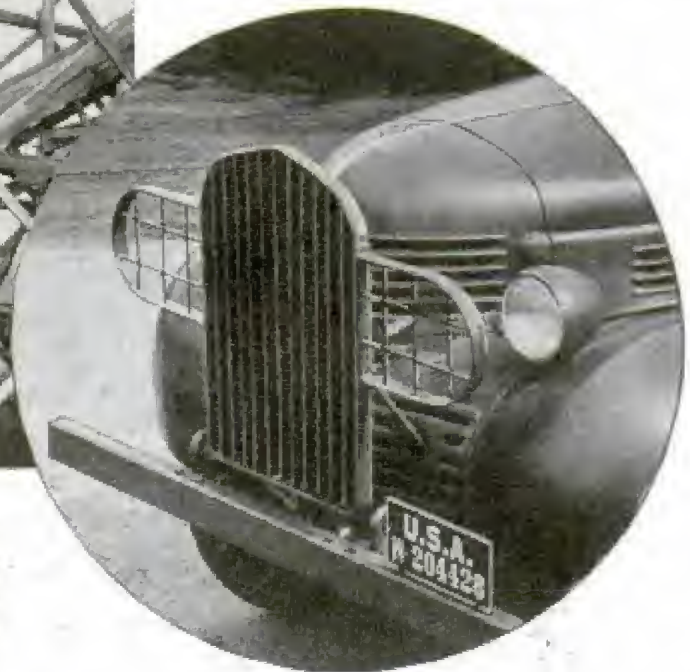
Army Trucks 'Go over the Top' in Stiff Tests

Reconnaissance trucks, designed for the United States army, run the gauntlet of grueling tests to prove themselves fit for field service. The olive drab vehicles have four-wheel drives, must maintain a top

speed of forty-five miles an hour on the level, and the fuel systems cannot falter on steep slopes or roughest terrain. To meet rigid army requirements, the light half-ton trucks, loaded with one thousand pounds, must be able to climb a sixty per cent grade in low gear, a seven per cent grade in high gear, and a five per cent grade—towing an extra thousand-pound load—in high gear. Carrying three thousand pounds, the one and one-half ton trucks must go up the sixty per cent grade in low, a five per cent grade in high, and, with an additional four-thousand-pound tow-load, climb a three and one-half per cent grade in high.



Above, one and one-half ton army truck bouncing up steep six-foot incline in test; below, light trucks must be able to ascend grades like this in low gear, carting a thousand-pound load. At the front ends (right) truck radiators and headlights are guarded by heavy metal grill



Metal Clip for Brace Block Strengthens Frame of House

Saw-toothed metal clips, just introduced in the building industry, are being used as

a brace block to produce a stronger wood-frame. The clip is installed simply by hammering its teeth into the vertical stud just under the cross brace, nailing one end of the clip to the stud and bending the other end to be nailed to the cross brace. This saves two saw cuts and three nails from each bracing assembly. In an engineering test, metal-clipped braces stood a weight of 19,060 pounds while a wooden brace block stood only 7,510 pounds.



Clip is driven into vertical stud under cross brace

Send stamped, addressed envelope to our Bureau of Information for name of maker of any device described in this magazine.

Iron Mines Charted by 'Fishing' through Ice



Lugging one of the portable huts on toboggans over ice, left, top, in search for ore deposits; and, bottom, engineer in hut reading meters. Right, magnet attraction of ore being measured from surface

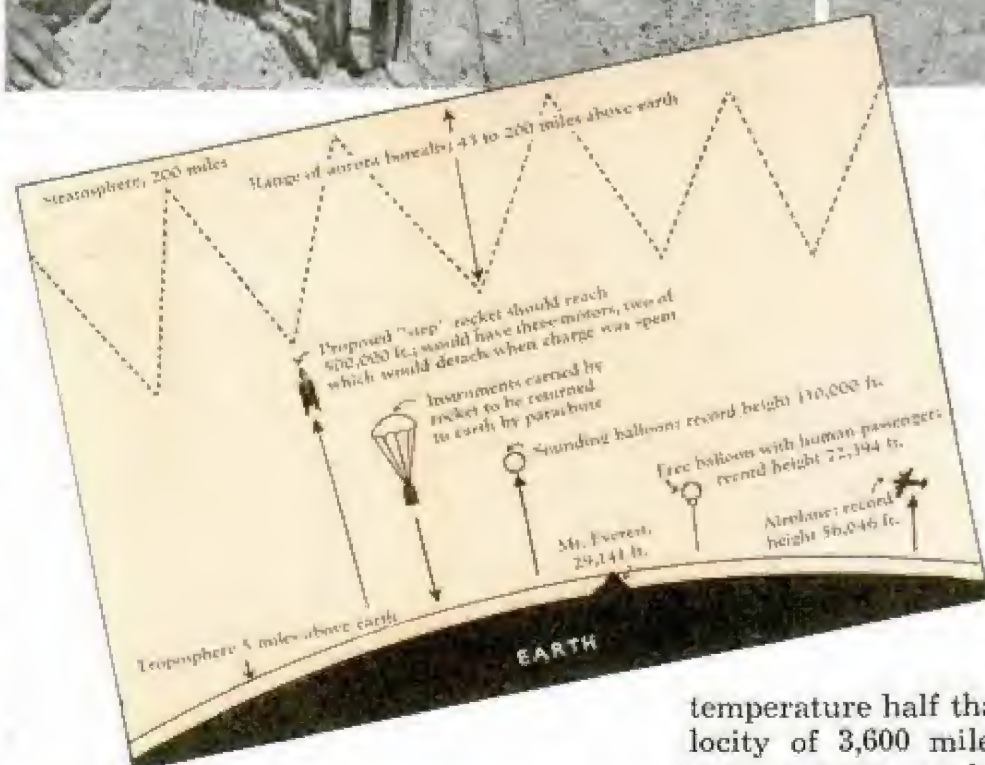
Ice two feet thick on Steep Rock lake in northern Ontario helped Canadian geophysicists in mapping four distinct iron deposits far under water, which are estimated to contain 300,000,000 tons of ore. After the contour of the lake bottom had been charted from boats, a survey was made through the ice with a torsion balance to determine the shape of the bedrock beneath the clay bottom. Portable electric plant, meters and other instruments were housed in an insulated shack mounted on toboggans which were moved from place to place, the electrical readings being taken by machinery in a box which the surveyors term a "torture chamber," "doodle-bug," or "count jeep." Three ten-foot electric rods were lowered through holes drilled in the ice, one rod being 1,000 yards from the other two. Gradually moving the two rods nearer the third one, the geophysicists could compute the quantity of

ore present, basing their calculation on the fact that the electric currents passing between the rods would vary with the amount of iron encountered. A third survey consisted of magnetic readings to learn the nature of the rock contents under the lake bottom. With the results of all three studies plotted on a large map, drillers took their four-ton rigs onto the lake ice and plumbed their casings and diamond drills through the ice, 150 feet of water, and another 150 feet of clay and bedrock, striking hematite iron ore which in some places proved even richer in iron content than that in the rich fields of Minnesota. On shore a shaft 800 feet deep has been sunk, with tunnels branching under the lake to hit the deposits, and a daily output of 2,000 tons is predicted, which will be brought to the surface from the underwater mine and shipped to blast furnaces for Canada's growing war industries.

Ref: University of Toronto
Toronto Ont Canada 209

Ref: John W. Parsons, California
Institute of Technology, Pasadena, Calif.

SEEKING POWER



Small test rocket is loaded into firing stand, upper left, to trace its characteristic path. Above, putting powder charge in rocket. Diagram shows man's altitude records and his hopes for the rocket

GUARDED by sandbags, a man sits before a panel on which are rows of gauges. As he turns valves, needles of the gauges spin and gyrate. From behind the sandbags comes a hiss, a puff of smoke.

The man relaxes, the gauges come to rest. If it were not for the tiers of protecting sandbags, it would seem undramatic, al-

most unimportant. Yet in those few seconds all the fires of hell have been raging in the little cylinder behind the sandbags. Terrifically explosive gases have just reached a

temperature half that of the sun and a velocity of 3,600 miles per hour—and one more experiment has been added to the long list by which men have sought to gain knowledge which will enable them to conquer outer space.

Scientists are hard-headed men. They do not speculate on traveling to the moon every time they see a sky rocket. They say simply:

"We are experimenting with fuels for

for SPACE ROCKETS



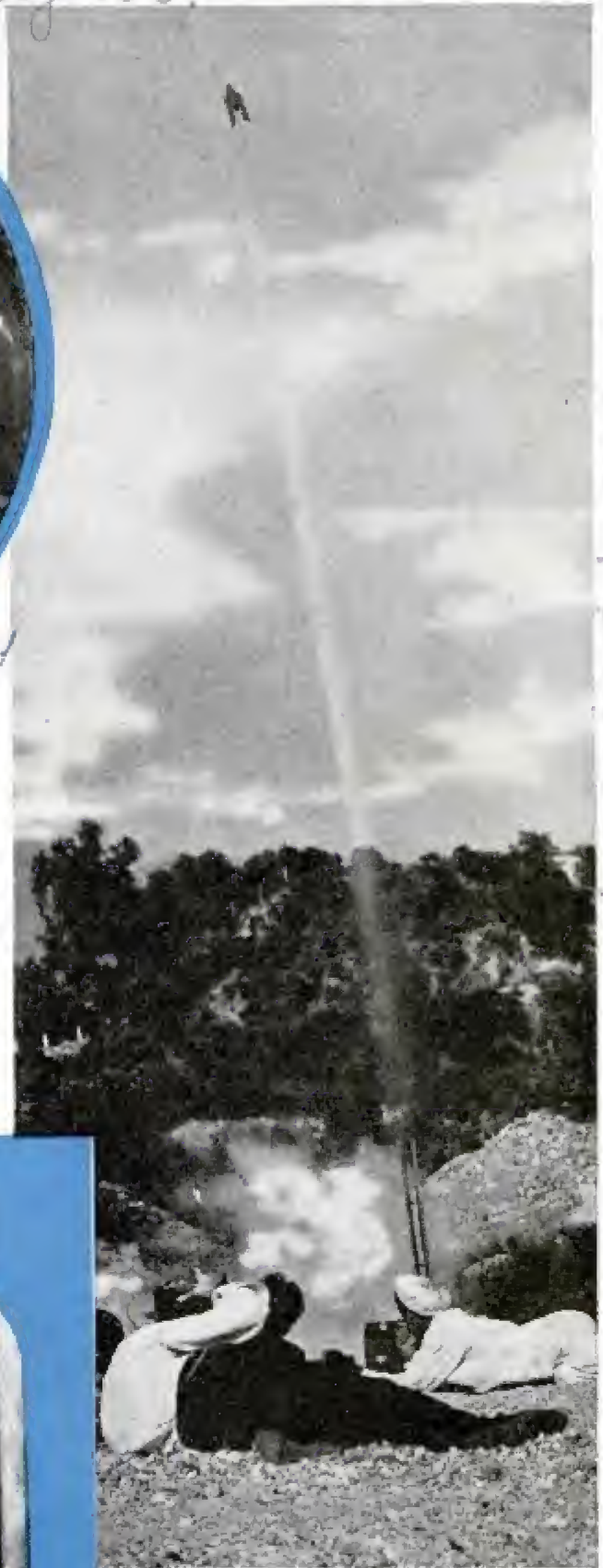
John W. Parson

rockets. We've found out a few things. It may be that in the reasonably near future science will succeed in sending a rocket higher than any man-made contrivance ever traveled before. Perhaps such a rocket might reach an altitude of 500,000 feet.

"If a rocket could be shot that high, it could carry recording instruments which would gather information of the greatest importance. A rocket to the moon. . . Men still dream of that. But science deals with facts. Still, the dream is perhaps a little bit nearer realization."

Behind that simple statement is another chapter in man's struggle to escape the chains of gravity which bind him to one planet.

Three years ago it was decided to study rocket motors at California Institute of Technology. Although many rocket experiments had been conducted throughout the world, no complete and systematic investigation of motors has been available. Yet it is just those



Test apparatus for rocket motors, in circle, records temperatures of motor and exhaust gases, speed of intake gases, amount of gas used, etc. Right, a rocket starts up fired by remote control. Below, test rocket used at California Tech



very problems of a powerful enough fuel and a long-life combustion chamber that are the stumbling blocks which are holding back rocket flights.

So three experimenters at California Tech., Frank J. Malina, John W. Parsons, and Edward Forman, decided to build a rocket which did not fly, a rocket which moved but a few fractions of an inch, but which told those vital facts about what goes on when a charge is fired.

As a background for their work, they had the long history of rocket experimentation, going back to the days of early Chinese culture when rockets were first used for fireworks displays. The western world did not begin to construct rockets until about the fourteenth

century. Immediately, the question of their possible military importance arose. But no one devised a successful military rocket until 1805, when William Congreve perfected one—and in so doing helped write the American national anthem.

For it was the Congreve rockets fired by the British forces attacking Fort McHenry that inspired Francis Scott Key to write the lines of the Star Spangled Banner, "and the rockets' red glare." Congreve rockets were also used with telling effect against Napoleon at Waterloo. Both incendiary and explosive charges were carried by these rockets. Not until modern artillery was developed did interest in military rockets wane.

However, the military potentialities of rockets have again come under serious consideration. With nations searching for new weapons, rockets were bound to have their day once more.

Major James R. Randolph of the U. S. Army recently set forth the advantages of military rockets. They are cheap, as no elaborate gun barrel or firing mechanism is needed. Rockets are fired from



To determine stability, a flying model is fired with powder by remote control, top. Center, recoil of spring gauges strength of powder fuels. Behind the sandbags (bottom) California Institute of Technology scientists test rocket motors and explosive fuel—mixture of oxygen and ethylene—developing 5,000-degree heat and gas velocities of 3,600 miles per hour



simple tubes. They are easy to transport. The tubes may be set up in a few moments, and a terrific fire concentration achieved suddenly, without the elaborate preparations which make artillery concentrations obvious to the foe.

But whatever the military significance of the rocket, its most dramatic and intriguing potentiality is that of conquering space. Although many older writers of fantasy speculated on space rockets, the first really practical experimentation in America was done by Prof. R. H. Goddard, beginning in 1909.

In 1918 Goddard published a set of calculations which he believed established the possibility of a rocket flight to the moon. If such a rocket could be constructed, he proposed that a small charge of flash powder be carried, and exploded when the rocket struck the moon. The flash would be visible to the earth's large telescopes.

Ten years later Goddard fired some experimental altitude rockets which attained a height of about two miles and a vertical

(Continued to page 118A)



Heavy barricade of stones is laid to protect operators before firing a rocket with its highly explosive charge (top). Dials in center show the fury of the thrust of a rocket motor in operation, its fuel consumption, temperature of motor and exhaust, and intake velocity. Three tanks of ethylene gas, shown at bottom, are on a delicate balance accurate to one-tenth ounce

Coin-in-Slot Movie Machine Shows Seventy-Foot Film



At the drop of a coin this machine shows a two and one-half minute movie on its ground-glass screen

Youngest member of the slot-machine family is a vendor of motion pictures. Drop a coin in the slot and the machine projects on its ground-glass screen for your entertainment a film lasting two and one-half minutes. Intended for cafes, stations, drug-stores and the like, each machine holds five seventy-foot film subjects. The 350-foot roll of film, changeable each week, lies flat on a series of rollers and goes through the projector endlessly.

Melting Pills Tell Temperature of Heated Metals

Tiny pellets that look like medicinal pills are being used in place of costly heat-measuring instruments to take the temperature of hot metals in industrial operations. Various pills melt at definitely known temperatures from 200 to 1,500 degrees Fahrenheit and are accurate within three per cent. They are used to prevent

cracks in metal processing, to make stronger welds, and to indicate the approach of safe-temperature limits when making costly castings, forging and machine equipment. Simple to use, the pellets will not corrode or pit the metal.

Auto Road Map in Small 'Bomb' Magnified for Easy Reading

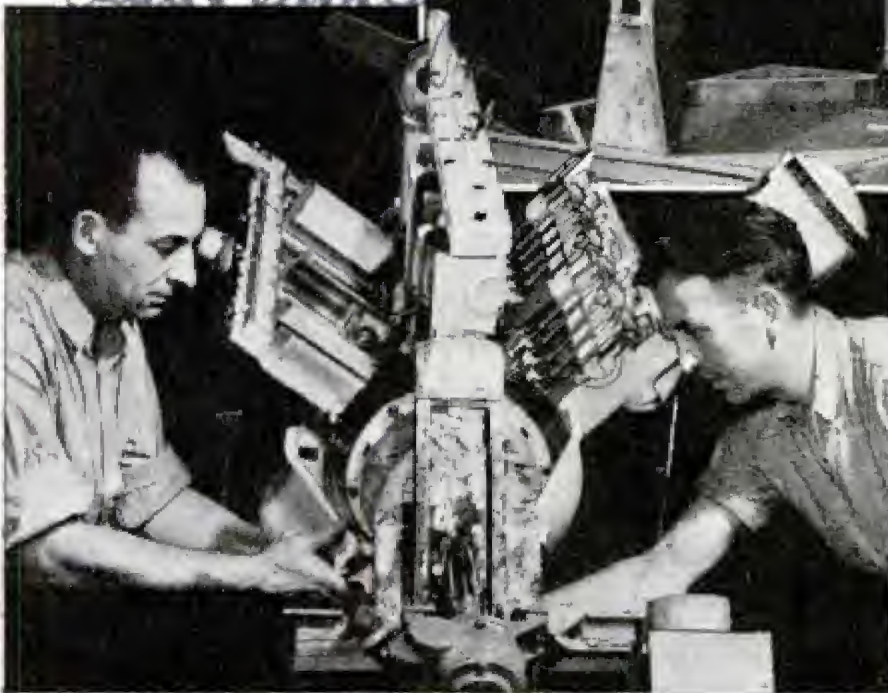
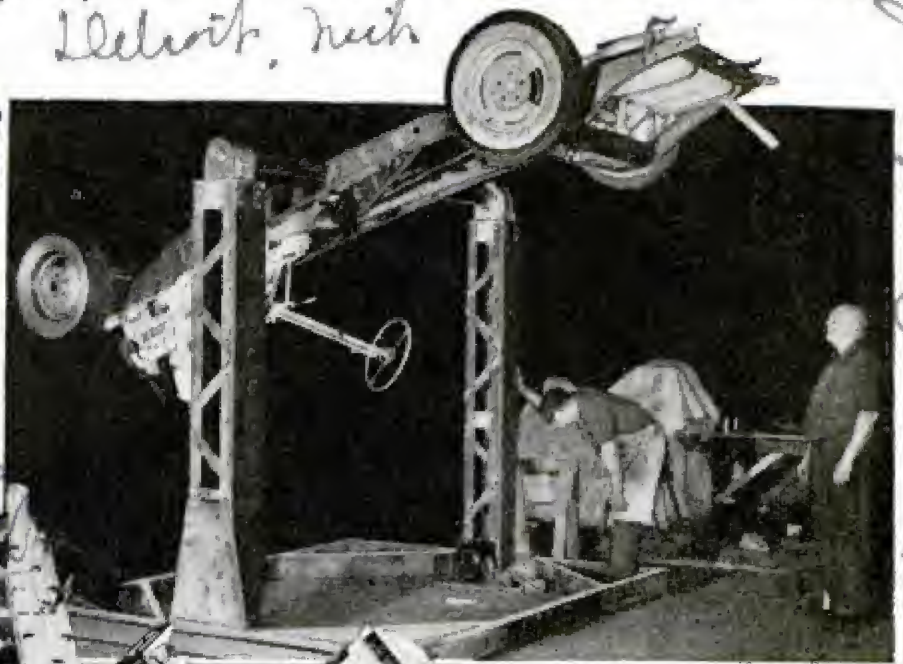
Despite its small size, a globular map clamped to the auto steering post shows highway routes for a large area of the United States. Inclosed in a bomblike case fitted with magnifying lens and light bulb, the map's minute details are enlarged so the driver can read them easily. The map is rotated north and south by raising and lowering a knob; east and west by twisting the knob. By combining these two motions a diagonal course can be traced. The globular map inserts are interchangeable.



Road map mounted on steering column has light inside and a magnifying glass to enlarge markings

Animated Displays Show How an Auto 'Ticks'

Full-weight automobile chassis, at right, balanced between pylons, swings gently end-over-end, in display trick at New York world's fair. Below, assembling engine that opens and closes like pages of a book and is illuminated so various parts are seen in action.



a pair of pylons. Near by is an animated engine that opens and closes, section by section, like the leaves of a book. With every part wired for lights and operated by separate switches, it is possible to illuminate any part of the engine in action. Flow of gasoline and exhaust is indicated by crumpled Cellophane in the cut-out manifolds, aided by flash-

Automobiles performing acrobatic stunts and magic tricks attract spectators to General Motors' exhibits of their latest models at New York world's fair and the automobile shows. In one display a full-size chassis appears to be balanced on a horizontal bar, swinging slowly end over end between

ing lights, synchronized to the speed of the engine. Colorless Cellophane is used for the intake and red for the exhaust. While the engine is running, you can peer inside such parts as cylinders, crankshaft, pistons and water pump through Pyralin windows fitted into openings in the curved surfaces.

Stainless Steel Wallboard Resists Rust and Corrosion

Wallboard surfaced with a thin sheet of stainless steel is unaffected by acids or chemicals and will not corrode, tarnish nor rust. It has a backing of plaster composition. Furnished in satin or pebble finish, the wall covering has many uses such as for shower stalls, sink coverings and hearth.

☐The human population of the earth has doubled since 1860, but scientists regard it as doubtful that the present population of 2,000,000,000 will ever be doubled.



DRESS REHEARSALS



Night flying is almost all by instruments even in good weather (top); below, plotting plane's position from radio bearings

THERE was silence in the air line's operations office as the flight superintendent hastily scribbled out a dispatch and passed it to the radio desk.

"Mayday message. Chicago to Trip Ten. Your midnight position report not received. If you are in trouble your best out is to fly northwest for twenty minutes. That puts you in the clear south of Omaha. Weather to the west and south is zero zero."

"Mayday"—from the French "m'aidez," help me—is the "SOS" of the air lines, yet this emergency message was never broadcast. Like scores of others it was just a rehearsal to test the efficiency of the men on the ground.

America's impressive record of safety in the air rests on the elaborate precautions that are taken to avoid hazards, and on the ability of flight and ground crews to

for

DANGER ALOFT

*Thomas S. Thomson, Jr.
8618 Malibu Road
Pacific Palisades, Calif.*



*American Air Line
Meteorologist, Sandy
Doyne*

handle the one chance in millions when something might happen. Daily the air-line staffs discuss combinations of circumstances that might cause a pilot trouble and decide on the best plan to follow in case of such an emergency.

Suppose that strong static is preventing a pilot from following his radio beam and a bad side wind is drifting him off the airway. What can the air line do to help him? Of course, the pilot has his radio loop and he can tune through the static to take bearings on several radio stations, then plot his position from the bearings. But time may be pressing and it's easier to do this paper work on the ground than in the cockpit. So the ground station,



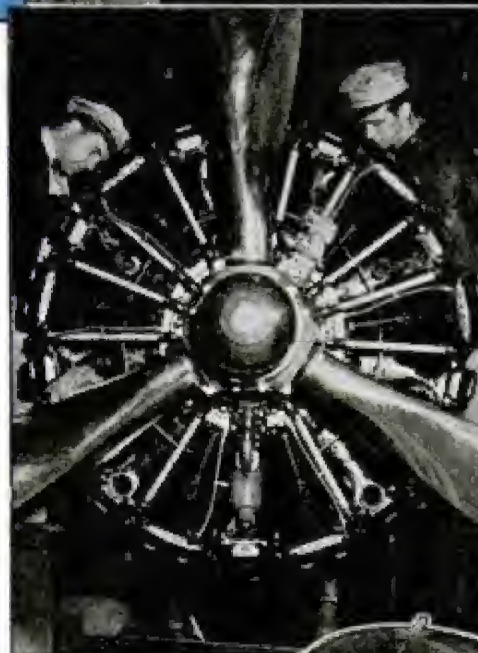
Meteorologist plots upper winds by watching rising balloon through theodolite, top. Below, American Airlines radio room



possibly 500 miles away, helps the pilot out by telling him where he is. The pilot takes the radio bearings with his loop, relays the information to the ground, and the ground does the rest. If necessary, the ground staff can even tell the pilot how fast he is traveling.

Accurate? Practice makes perfect and positions are plotted every day, just for practice. In good weather the pilot can check up visually on how well the ground crew locates him.

A westbound American flagship pilot radios a practice position request to Burbank: "Compass 255, March Field 0, Daggett 75, San Diego 300. Position please?" When the message reaches the flight superintendent he calculates the variation of the compass bearings and picks up an avigation protractor. One arm of the protractor is moved to the bearing of March Field, a second to the bearing of Daggett, and a third to the bearing of the Long Beach radio. Then he lays the protractor on the airway chart, turning the instrument so that each arm is over its own station. The intersection of the arms marks the location of the airplane at the time the bearings were taken. Allowing nine miles of on-course progress for the three minutes that will elapse before



the answer reaches the pilot, the flight superintendent makes a hasty calculation and writes out the message: "You are four miles northwest of the Palm Springs airport." At once by radio comes back the reply. "That's right."

A second "fix" plotted ten minutes later by the ground staff from a second set of bearings taken by the pilot is used to



Top, left, TWA men distribute load properly with balance computer; right, automatic computer lays efficient flight plan. Center, engine inspection; bottom, checking maze of instrument cables in nose

figure the miles per hour the plane is traveling over the ground and shows the direction in which the plane has been flying, information that helps the pilot check on the direction and velocity of the wind.

An improvement on which the air lines are working jointly is a proposed system of ground radio-compass stations. By listening to an airplane's transmitter, two or more of the ground stations could swing their loops to tune the signals to peak intensity. The intersection of these bearings, plotted on a map, gives the exact location of the plane and the pilot can be notified at once.

Suppose an air liner's radio transmitter fails and the pilot isn't able to make his regular half-hour position report. Weather conditions are unexpectedly getting worse and it's imperative to reach the pilot. What's the best thing to do? Just because the plane's transmitter is out of order doesn't imply a real emergency. The pilot may be continuing on schedule, flying the beam, although unable to report his progress. But the ground staff takes no chances and supplies him with the latest weather information and comprehensive advice based on it.

Suggested circumstances like these were responsible for the practice "may-day" message outlined above. Before the message was prepared some fast work was done. First the location of the plane had to be determined and then the best course for the pilot had to be de-

(Continued to page 114A)

On the line for night takeoff, top. Center, "fog eye" being developed to utilize infrared rays and photoelectric cell to produce picture of ground on pilot's television screen. Lower right, cockpit of liner testing automatic direction finder. Left, United Air Lines' "flying laboratory"



Vertical handwritten text on the right margin:
P.C.A. Automatic Direction Finder
Sperry Corp.
United Air Lines
"flying laboratory"

Helmet Carries Photofloods Leaving Both Hands Free



Two reflectors clamped to another which is worn helmet fashion free hands for manipulating the camera

Difficulty experienced in juggling lights and camera at the same time led one camera enthusiast to devise headgear for holding the photofloods. After the photofloods are adjusted both hands are left free for operating the camera. The unit consists of three reflectors, one being worn as a helmet, with the others clamped to it.

Engine Weighing Half an Ounce Has a Four-Drop Gas Tank

Already producing a miniature two-cycle gasoline engine for midget race cars, airplanes and power-boat hobbyists, Ray



At right is the miniature gasoline engine for model planes and cars; at left, the tiny model

Arden of Baldwin, N. Y., has now built a tiny model of his model engine. The new "baby" has a bore and stroke of five-sixteenths inch, spins a propeller at 15,000 revolutions per minute and complete with a propeller it weighs only 215 grains—about three-eighths of an ounce. The spark plug weighs only four and one-half grains and took him 100 hours to make. The gas tank holds four drops of fuel, and is filled with a medicine dropper; the jet through which the gasoline enters the cylinder can be seen only with a magnifying glass. Measuring $1\frac{1}{16}$ inches high and $\frac{7}{16}$ inch wide, the engine runs four minutes on a full gas tank, developing unusually high power for its displacement. The larger engine of which it is a copy weighs one and three-fourths ounces.

All-Wheel Springs for Trailers Ease Ride in Touring Home



Trailer axle assembly provides individual spring for each wheel, resulting in a restful, easy ride

By giving each wheel of the house trailer an independent spring, riding action becomes so smooth, it is claimed, that a person can sleep comfortably while the trailer is in motion. Main springs of the new axle assembly may be varied for trailers of different types and weights to obtain the best riding quality.

TUNING IN *the* NEXT PRESIDENT



FOR the first time, television has joined hands with radio to portray by sight and sound a national political convention choosing a nominee for President.

Owners of sets from Massachusetts to Pennsylvania, an audience of approximately 40,000, are the privileged few to whom the picture story of the Republican convention has just been unfolded. Lack of telecasting stations, receivers and a means of piping the programs to all sections of the United States necessarily limited the audience.

Bringing all the exciting sounds of the two conventions to the millions of Americans who own standard broadcast receivers, is the gigantic task of the big networks—National Broadcasting Company, Columbia Broadcasting System and Mutual Broadcasting System. For months before the first convention, executives carefully planned for complete coverage and engineers designed new equipment, or improved old, so that reception might



At top, NBC mobile "pickup" equipment. Bottom, a radio booth erected to cover one of the national party conventions



activity into a coherent picture for the radio audience and devising ways for explaining what that picture means. Next to him sits an ace reporter of the network. The booth is strategically placed to command a view of every part of the huge auditorium. With great floodlights directed at the stage, over which the booth is hung, both men must wear dark glasses.

As we look out of the window, a hundred things seem to be happening; on the main floor where the delegates sit; in the balconies where spectators hang on the rails to see the floor; on the speakers' platform, almost directly below, and in the press gallery, with a radio section for the first time in history. Also in the booth are the network's chief technical aide and an assistant, both wearing telephone headsets and in constant contact with the control room of the local network point. Through this point pass all of the network's programs, and at a nod from the director the engineers flash the local station, cut off the running program and tune in the convention.

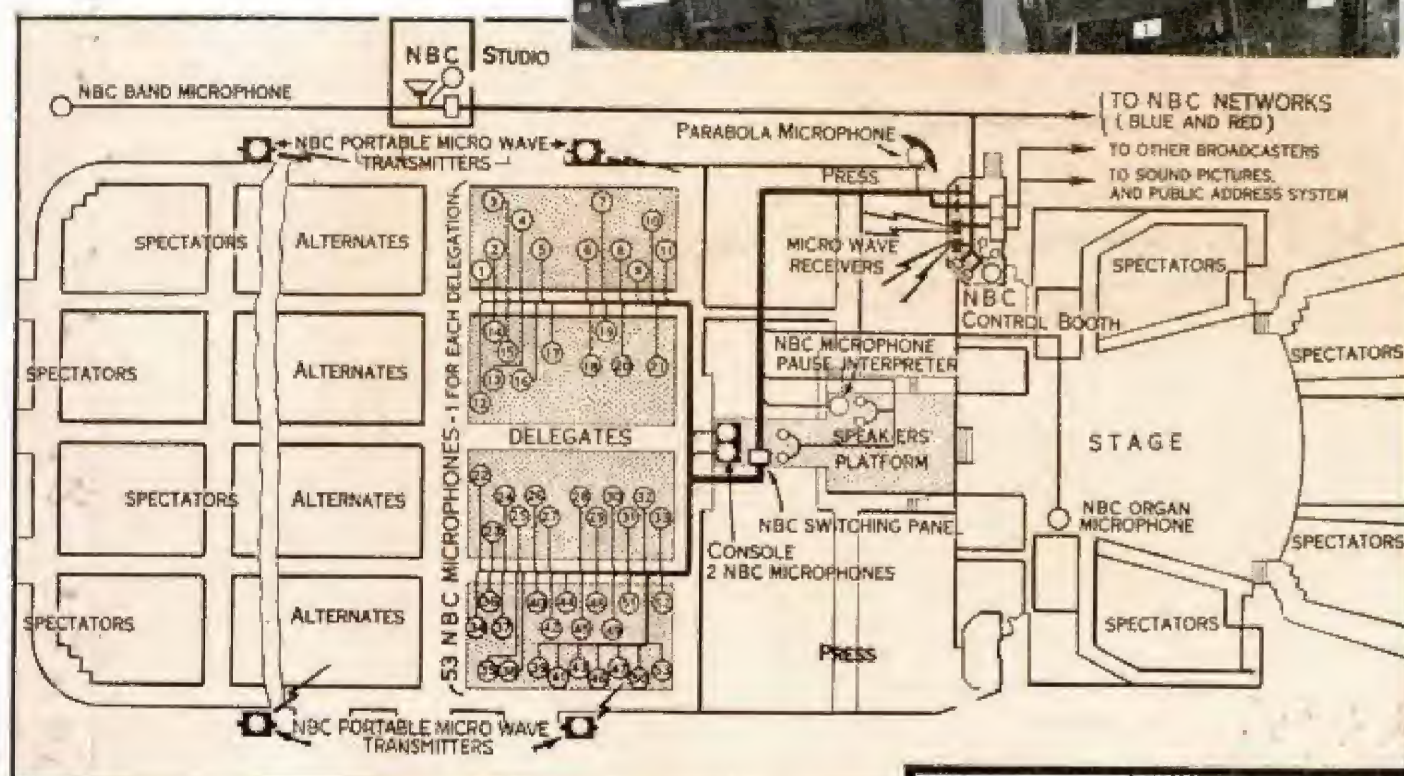
Top, the CBS "walking" short-wave transmitter covers convention floor. Center, parabolic "mike" tuned on convention hall. Below, left, switchboard with buttons controlling fifty-four microphones among delegations; right, mobile television units

be as near perfect as possible.

Let's imagine ourselves in one of the big network booths at the Chicago Stadium where the Democratic convention meets. Below us the hall is crammed with delegates. Beside us sits a man who heads the job of translating their



From a small rostrum directly below the booth, the principal speeches are picked up. Here stands the permanent chairman of the convention; the raps of his gavel are heard over a battery of four microphones wired to the control booths of the major networks, and to a control booth for the public-address system of the hall, so that any activity on the rostrum is heard simultaneously through the auditorium and in the homes of



Each delegation has its microphone, top. Diagram shows how NBC covers a convention. Below, "beer mug" transmitter

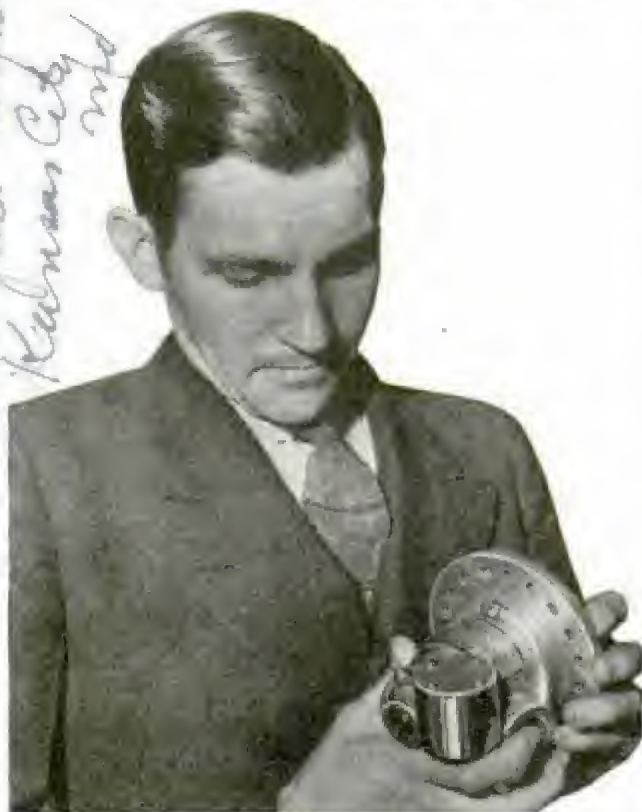
the nation. The rostrum is at the front center of the speakers' platform, an enormous stage seating all the national committeemen of the party, and the important speakers and guests. Sitting at a small table near the front of the platform is a radio news analyst, or commentator, with a microphone. His job is to cover all activity on the platform.

In front of the speakers' stand is the big press gallery and beyond, stretching to the far end of the auditorium, is the delegates' floor. The floor is served by more than fifty separate studio-type microphones wired into one of the most complex circuits ever arranged. These microphones, one for each state delegation, were set up by the three major networks. All the microphones are wired to

(Continued to page 140A)



Starter for Light Airplanes Uses Hydraulic Power



Hydraulic starter for light airplanes, needing no battery to operate it, weighs only fifteen pounds

Doing away with the necessity for a battery, which makes conventional starters too heavy for light airplanes, a fifteen-pound hydraulic starter has been designed specially for the smaller craft. It is operated by turning a handle at the instrument panel, and when the starter runs down, it can be pumped from inside the ship.

Three-Dimension Air-Line Map Charts Routes of All Planes

Scheduled flights of every airplane in the service of American Airlines are shown at a glance with a mechanical toy-like device



Air map showing flight schedules in third dimension

having bright-colored strings attached to it. Made of transparent Pyralin, it resembles a chart of the Airline's system at the top, and down the sides are lettered the hours of the day. Strings of various colors denoting types of airplanes—red for twenty-one passenger DC-3's, blue for Flagship skysleepers, and green for fourteen-passenger day planes—are fastened at the top at points where the planes are based, and each string traces the route of the plane from the base station to its destination, and indicates also turn-arounds at destinations. The three-dimensional map replaces charts which have been used in routing the big air transports.

Water Heater with Table Top Adds Handy Work Space



This enclosed gas-operated water heater serves the additional purpose of furnishing a working table

Taking up little space in the kitchen and adding a convenient working place, a gas-operated water heater has a table top of regulation height. It is automatic and available in twenty or thirty-gallon sizes.

Heroic Ten-Ton Plaque Cast in Stainless Steel

First heroic sculpture ever cast in stainless steel, a ten-ton plaque just installed over the entrance to the Associated Press building in New York's Rockefeller Center symbolizes America's free press. Measuring twenty-four by eighteen feet, it was made of an alloy of chromium, nickel and iron and was poured in nine sections weighing more than a ton each, at a temperature of 3,000 degrees Fahrenheit. At this terrific heat special techniques had to be worked out to keep the metal from destroying the sand molds. The problem was solved by rigging up "bathtub" arrangements on top of the mold, then building into each mold a



At top, Sculptor Isamu Noguchi finishes full-scale, eighteen by twenty-four foot plaster model of the Associated Press plaque. Below, top section of the plaque, the first piece cast; right, assembled plaque

whole network of channels that would carry the molten metal quickly and evenly over the whole surface. The "bathtubs" were fitted with big plugs that could be pulled out simultaneously, and thus the casting of each section actually was accomplished in a second or less. Weeks of preparation were required before the casting, the sand molds being packed hard under pressures as high as a thousand pounds.

The sections afterward were polished, trimmed and fitted together to an exactness of 1/1,000 inch. The figures in the sculpture represent newspaper men armed with pad and pencil, camera, telephone, Teletype and Wirephoto.

Send stamped, addressed envelope to our Bureau of Information for name of maker of any device described in this magazine.

MIRACLE MEN



Photo courtesy
Pioneer Hi-Bred.

Top, left, sorting ears of hybrid corn; right, seed-treating machine which adds mercury dust to corn, destroying mold and assuring high germination. In circle, five men stand on platform supported only by four hills of sturdy hybrid corn

THEY called a farmer a wonder man five years ago if he could raise 100 bushels of corn to an acre. Today, he'd be lucky to make the championship flight in a county growing event.

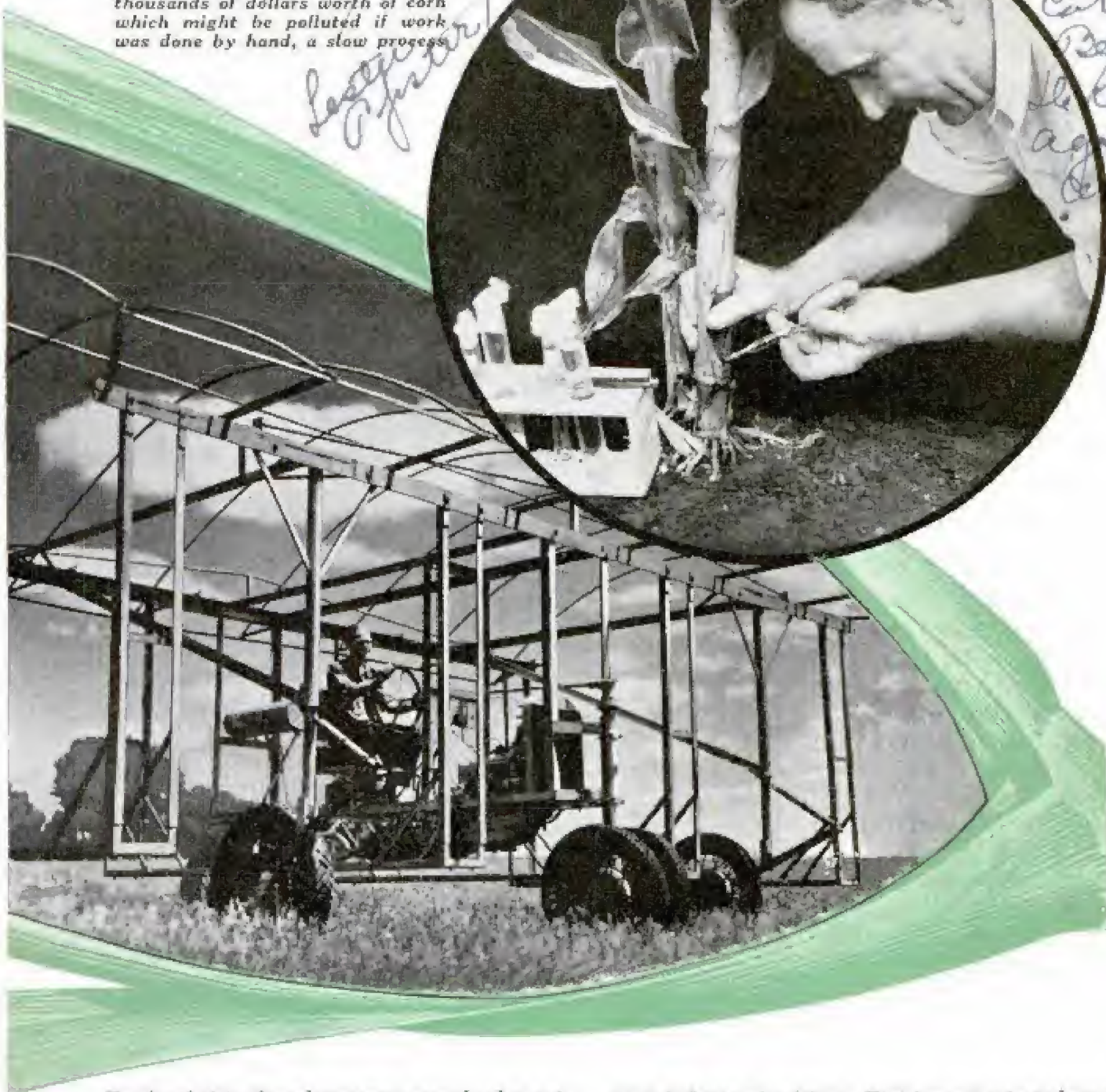
Up and down the Corn Belt, yields have shot upward. An Illinois farmer last fall reported 171 bushels to an acre on a test patch of eight acres. The winner of a ten-

acre yield contest of a farm group raised 137.96 bushels to an acre while the crops of 268 county corn-growing champions averaged 114 bushels.

This is only the beginning. With the full mastery of new corn-breeding methods and with more efficient cultivating and planting, agronomists predict harvests may reach 200 bushels to the acre.

of the CORN BELT

Right, corn plant is inoculated with fungus organisms to determine susceptibility to disease. Machine below speeds detasseling, saving thousands of dollars worth of corn which might be polluted if work was done by hand, a slow process.



Back of this development stands the scientist in straw hat and overalls who's taken the laws of evolution and reproduction into his own hands to develop a hand-tailored corn. He's literally taken apart the established varieties, chucked out their weaknesses, reassembled their superior traits in new corns.

The inbred corns that survive look as if they've been through a hard summer in the Dust Bowl. The stalks are small, the

ears inferior looking. But by crossing these nubbins with another strain that's been put through the same procedure, a highly productive, uniform corn results. In fact, hybrid corns, as they're called, look as if they came off an assembly line. Yield and uniformity are only half the story. They mature earlier, which is important, because a crop that's already "made" a few days ahead of a long, dry spell will probably make the grade where a crop that's

The corn-seed breeders are "building" hybrids suitable for different soils and climates; hybrids that expedite the use of mechanical corn pickers by dropping only a small percentage of ears from the stalks; hybrids the searing winds, grasshoppers, or disease can't lick, and lastly, new corns particularly suited for livestock feeding and industrial uses.

A government expert, Frederick D. Richey, likens hybrid corn to a mule. The latter is a first-generation hybrid between the mare and the ass, with the mother's size, the father's stamina. A mule does not reproduce. The miracle corn is a first-generation cross involving two or more inbred strains of corn. A good hybrid will produce more and better corn than any standard variety. But the resulting corn is useless as seed for the next crop.

Top, bagging a tassel; center, inbred type throwing out roots from stalk; below, uniform hybrid kernels give accurate drop

produced on the same stalk and no other. This was inbreeding.

For the next few years, the procedure was followed. Thousands of bags were used but the crops lacked any uniformity. There were stalks the size of saplings, others too frail to stand a hard blow. A few stalks produced big ears but no kernels, and others were discarded for poor root growth. The open-pollinated Krug corn was, under the strain of inbreeding, breaking down into the traits of scores of ancestors. Here was plant evolution in reverse. Only the best specimens were saved from each generation and replanted the following year. Year by year the plants grew more uniform but their yield and vigor diminished. Some varieties couldn't stand repeated inbreeding and had to be thrown away.

Five years found Pfister down to four puny ears, inbred so long their good qualities had become fixed. He proceeded with the second step, that of making crosses.

In his field laboratory the next year were eight test plots, each containing three short rows. The middle row he designated as the pollinator or sire, and left the tassels growing; but from the stalks in the rows on either side he

(Continued to page 120A)



*Franklin D. Roosevelt
Blossington, Ill*

Notice sturdy structure of stalks and ears at top. Center, strong-rooted hybrid contrasts with inferior-rooted strain at right. Bottom, hand sorting to winnow out damaged ears before grading

Notice sturdy structure of stalks and ears at top. Center, strong-rooted hybrid contrasts with inferior-rooted strain at right. Bottom, hand sorting to winnow out damaged ears before grading

Perisphere Dwarfs Painters Crawling over It Like Flies



Down the face of the globe crawls the spring clean-up squad, busy at the vast job of painting the Perisphere for the 1940 New York world's fair

One of the world's biggest decorating jobs this spring was the repainting of the Perisphere at the New York world's fair. Swinging down from the "top of the world" on long ropes, the painters looked like tiny flies crawling over its vast surface.

Auto Might Be 100 Years Old but It Waited for Gasoline

Most of the principles built into the modern automobile were known long ago. The sliding-gear transmission is almost 140 years old. The differential gear is over 100. Rubber tires were patented almost a century back. The first crude internal-combustion engine chugged before Benjamin Franklin was born. Self-moving road

carriages of a sort ran on English roads more than 100 years ago. The automobile is an assembly of mechanisms developed a century or more ago, but the gasoline automobile itself lagged because gasoline and oil were so long in coming. It was not long after gasoline arrived in the 'sixties that gasoline cars began to be built.

Air-Speed Indicator for Auto Mounted in Door Mirror

You can keep a constant check of the air speed of your car, and compare it with the land speed, by installing an outside mirror equipped with an air-speed indicator. Wind velocity is shown on a dial marked from ten to 125 miles per hour in brightly colored figures easy to read, the dial being turned by a three-vane rotor at the back of the mirror. The unit is designed for mounting on the outside of the left front door. Exposed parts are chrome plated and the Bakelite rotor is treated to resist weather. A rigid die-cast swivel allows the mirror to be adjusted to any angle.



As car travels, numbered dial indicates air speed. Wind rotor, not in picture, is other side of mirror

122 E. 42. New York.

Luminous Signal Hails Navy Seaplanes to Port

Guarding the French "life line" across the Mediterranean to its colonies in north Africa is a new naval air base at Aspretto, on the Gulf of Ajaccio in Corsica. A dike protects the landing basin for seaplanes from the open sea, and, once on the water, the planes taxi



x 500
At top, operator at French air base in Corsica signals plane down with light beam. Below, hoisting a big seaplane ashore with a powerful crane

within reach of a powerful crane which hoists them ashore. Vast sheds have been built for refueling and repairing the aircraft and spacious quarters are provided for the crews. At the air base there is a powerful luminous signal with which the base headquarters and seaplanes in flight exchange messages.

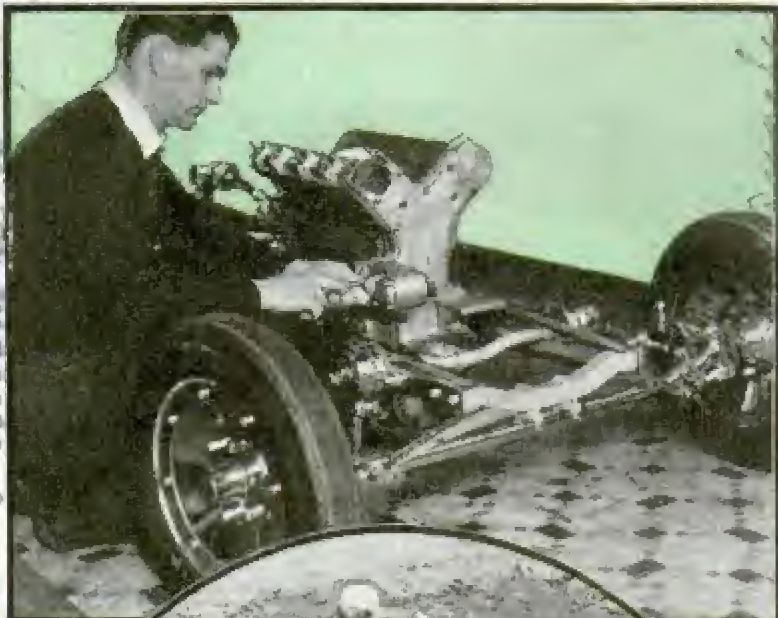
Drill Cuts Rivet from Plane Skin without Enlarging Hole

It often becomes necessary to drill out rivets in an airplane's "skin," and when this is done with ordinary tools it usually makes the hole larger, requiring a larger rivet. As a remedy, an airplane mechanic invented a drill attachment that fits at the end of the drill chuck, enabling the workman to drill straight through the center of the head of the faulty rivet without affecting the "skin," so the rivet will fall out easily. This permits a rivet of the same size to be used, thus avoiding the irregularity resulting from unequal rivets.



Andy White
Removing rivet with special drill attachment

1941
Cmt. Thos. E. Stinson, Jr. 18618
Malibu Road, Pacific Palisades Cal



4182 S. Vermont, Detroit, Mich.

MIDGET auto racing is so popular this year that good drivers can race every night in the week with a couple of matinees thrown in, if they wish. During the summer season a busy driver follows a timetable packed with action and there's hardly an hour when he is not racing, working on his car, sleeping, or traveling to the next track.

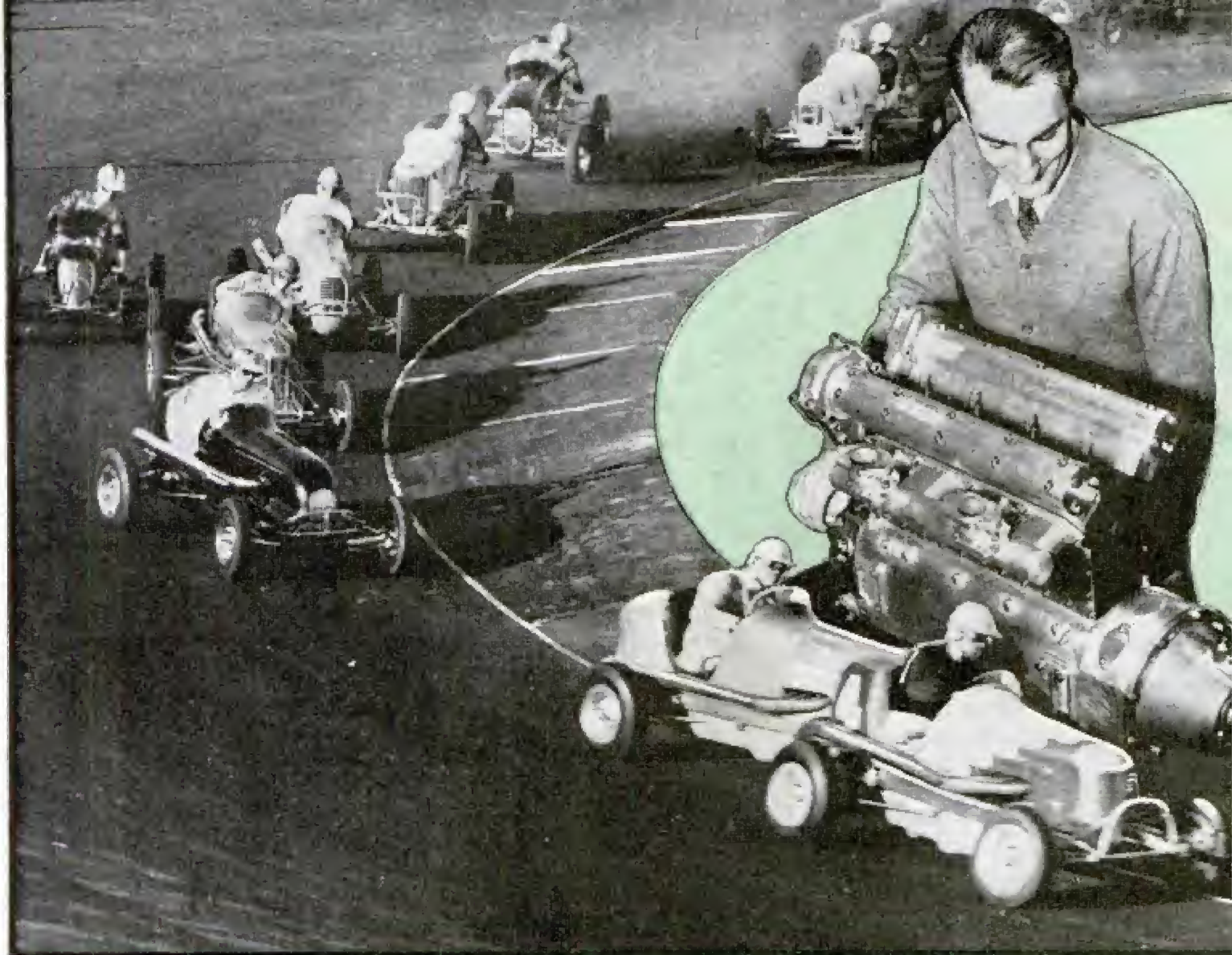
Leading drivers such as Ronnie Householder, who won last year's championship race at Chicago, may schedule 100 or more races between May and October. A broken shoulder laid Householder up when he went through the fence last season after sixty races, of which he won thirty-five and placed among the first three for the balance except for half a dozen times when his engine "blew up."

To keep abreast of a grueling schedule like that calls for careful planning. Householder makes his headquarters at Pontiac, Mich., accessible to the tracks at Detroit, Toledo, Cleveland,

KEEPING *the*



Chassis and engine are torn down completely every week in race season, top. Circle, attempting to pass car on rail at turn. Bottom, midget car assembled from stock parts ready for race



MIDGET RACERS *Rolling*

Grand Rapids, and Kalamazoo. This year, with two race cars, he travels in a station wagon and tows a double-deck trailer on which the cars are carried. Johnny Wolfiel is the other driver of the team. After each race the pair travel several hundred miles to the next track, catch a few hours of sleep, and get up in time to begin preparing their cars for the race that night.

First the body is washed and the chassis inspected for cracks. If the motor wasn't quite right the night before, it is tuned up. Tires and the rear-end gear ratio may be changed to fit the conditions of the coming race. Once a week each engine is torn down and new rings fitted. The valves may need grinding at the same time. After twenty or more races, depending on the amount of dust that has filtered into the engine, it is rebored and rebabbitted.

A well-equipped car has plenty of spare parts. Shafts and motor parts are most apt



Top, sliding the turn, and a 200-pound, 100-horsepower motor; below, "nerfing" bar for safety in collisions



to fail in racing. Axle shafts, crank and clutch shafts, springs, shock absorbers, spare gears, boxes of spark plugs, and as many as eight spare tires and wheels of different treads and sizes to suit different tracks are part of the equipment. Some drivers carry a spare block, with pistons and valves fitted, ready to mount on the crankcase.

Preparations for a race aren't finished until just before the race begins. A change in the weather may necessitate a change of fuel and spark plugs. The qualifying trials are usually made with a high gear ratio, after which the ratio is changed for the race itself. On a damp night the burned gases from the exhausts may hang over the track and the carburetor will need a last-minute adjustment. If the trial dashes dry out the track's surface, tires may be changed in a hurry to take advantage of the new conditions.

Being a consistent winner takes more than superb driving. Competition is so intense that a leading driver must constantly improve his car to keep in the lead. The trend in engineering is to develop lighter cars that ride the tracks more perfectly, transforming more of the available engine power into speed. Cars that bounce around and toss their wheels off the ground in the turns are beaten by cars easier to control.



Above, three drivers try desperately to miss pair that have collided at high speed in night race. Left, cut-away piston of midget engine showing interior construction, and new type of midget connecting rod. Below, installing main bearings of new Sampson midget racing engine



Householder's new car has a total weight of 690 pounds as against an average weight of 850 pounds. Weight was saved at every possible point. There are no housings on the rear axles. The frame is of light channel steel, the steering box is an aluminum casting, and special shock absorbers that weigh fourteen ounces instead of five and

6117 S. Vermont Pl.,
Los Angeles

Los Angeles, Calif

one-half pounds each are used. The shocks have the additional advantage of delivering immediate and positive action, helping to keep all four wheels on the track. The car is powered with a new Sampson motor.

Fred Offenhauser, builder of stock racing engines for midget cars, is experimenting with a new chassis that has a novel independent wheel suspension in front while between the rear wheels is a cross spring hinged in the middle. The purpose is to keep all four wheels vertical and in contact with the track at all times, the body being permitted to roll in the turns. Each front wheel is attached to a coil spring housed horizontally inside the hollow front cross bar of the frame.

Alden Sampson, race car owner who has entered the field with a new stock lightweight 100-horsepower engine, is also building an experimental chassis for a car that is expected to weigh only 600 pounds. Suspension of this car is to be about the opposite of the new Offenhauser, with one cross spring in front while each of the rear wheels is independently sprung by means of a twenty-four-inch alloy steel torsion bar, the rear end of which is connected to the wheel and the front of which is anchored to the frame.

Sampson's new engine runs counter-clockwise like an aircraft engine, the purpose being to transfer engine torque to the left side of the car to prevent the left wheels from rising in the turns.

The four-cylinder engine weighs 200 pounds complete with transmission, and develops 100 horsepower at 6,500 revolutions per minute. Bore is three and one-eighth inches and stroke is three and one-fourth inches. There are four valves per cylinder, overhead camshafts, and two carburetors designed to use leaded gasoline instead of expensive alcohol. The counterbalanced crankshaft is supported by five main bearings. Connecting-rod bearings are of the shell type, the bearing caps making a saw-toothed fit with the rods to prevent side twist. Bearings can be replaced rapidly and at slight cost. The new engine is thirty-four inches long, fourteen and one-half inches wide, and twenty-one and one-half inches high. The design permits use of supercharging equipment. Both Sampson and Offenhauser are manufacturing quick-change transmission assemblies that permit changing gear ra-

(Continued to page 140A)

Children's Homebuilt Swing Has Interchangeable Seats



Safe swing for children, top, fitted with closed-in seat; bottom, bicycle-type seat for older children

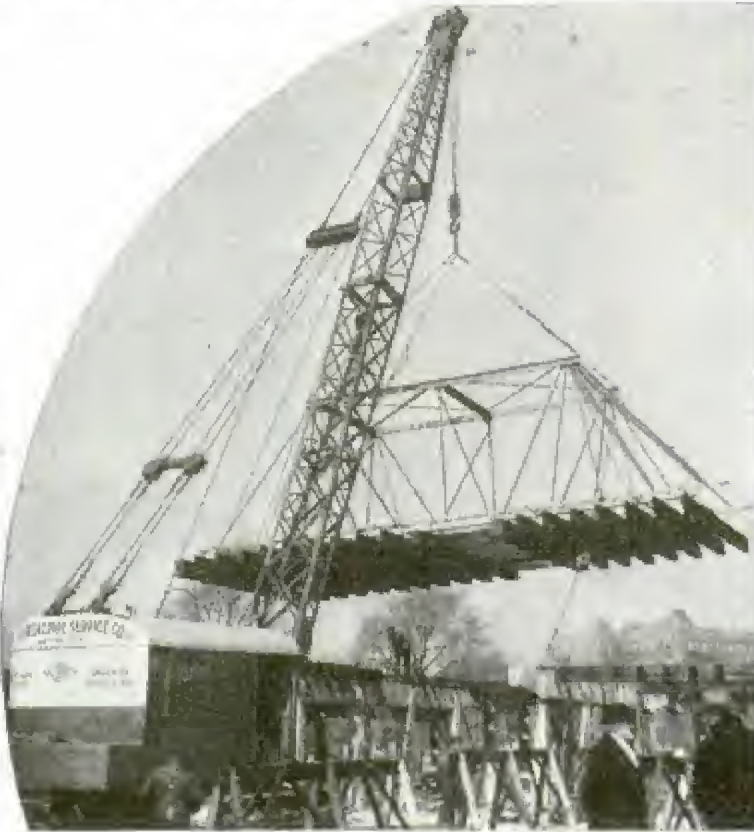
To provide new thrills for his children, one father built a swing which can be used safely. It may be fitted with seats suitable for either small or large children. An airplane body, in which the smaller ones sit fully protected, is propelled by pushing and pulling on a bar at the front. For larger children, a body with bicycle seats and handle bars can be substituted.

When their home is flooded, the vicious driver ants of Liberia—inch-long blind ants—form a ball which rotates as it floats in the water, keeping them from drowning by remaining under water too long.

Charles J. Eckley
1617 N. 39th, Seattle, Wash

W. H. Milhaman
1617 N. 39th, Seattle, Wash

Steel "Strongback" Lifts a Five-Ton Sidewalk



Whole sections of the boardwalk at Coney Island were picked up bodily and transplanted to a new location with the help of a steel frame, nicknamed "strongback" by the contractors. The bridgelike carrier, which weighs two tons, was designed to distribute evenly the strain of lifting the five-ton sections and moving them by crane as far as 350 feet. It proved a real time-saver in "straightening" a 4,000-foot length of the boardwalk to enlarge the beach front area.

Five-ton sections of boardwalk, above, are picked up and carried by crane to new location, sometimes 350 feet away. Right, note bridge-like structure of "strongback" with forty hooks swinging from 'tracks' at sides



100,000,000-Volt Atom Smasher to Probe Matter's Secrets



New attacks will be directed against the atom to unlock its pent-up secrets when the giant of all atom smashers is completed at University of California. The cyclotron will produce energies in excess of 100,000,000 volts, about triple the voltage of the university's present atom smasher, and will weigh 4,900 tons, which is more than twenty times heavier. As compared with the sixty-inch magnet of the present instrument, the

Drawing shows how 100,000,000-volt cyclotron will appear when finished

Hannover. Linder
new one
 new one will measure 184 inches. The structure will be fifty-eight feet long and fifteen feet wide, with a height of 36.8 feet, of which 11.8 feet will be underground. Its control room will be located underground, 150 feet from the cyclotron. While nothing is known about the possibilities with such enormous energies, the primary objective is to open a way to study new regions of the atom, an infinitesimal planetary system that is the "building block" of material substances.

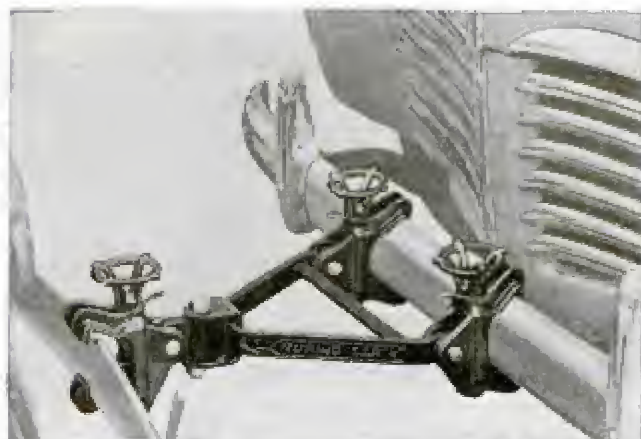
Four-Gun Man in a 'Blister' Guards Tail of Air Bomber



and
 Guarding the tail of a British bombing plane, the machine gunner in his glassed turret can maneuver his multiple guns in all directions

Flanked by a brace of machine guns on each side, a "four-gun man" in a "blister" guards the British bombing planes from enemies attacking the tail. His glassed-in turret affords a wide enough view to prevent any surprise attack.

One-Man Towing Bar for Auto Is Attached without Tools



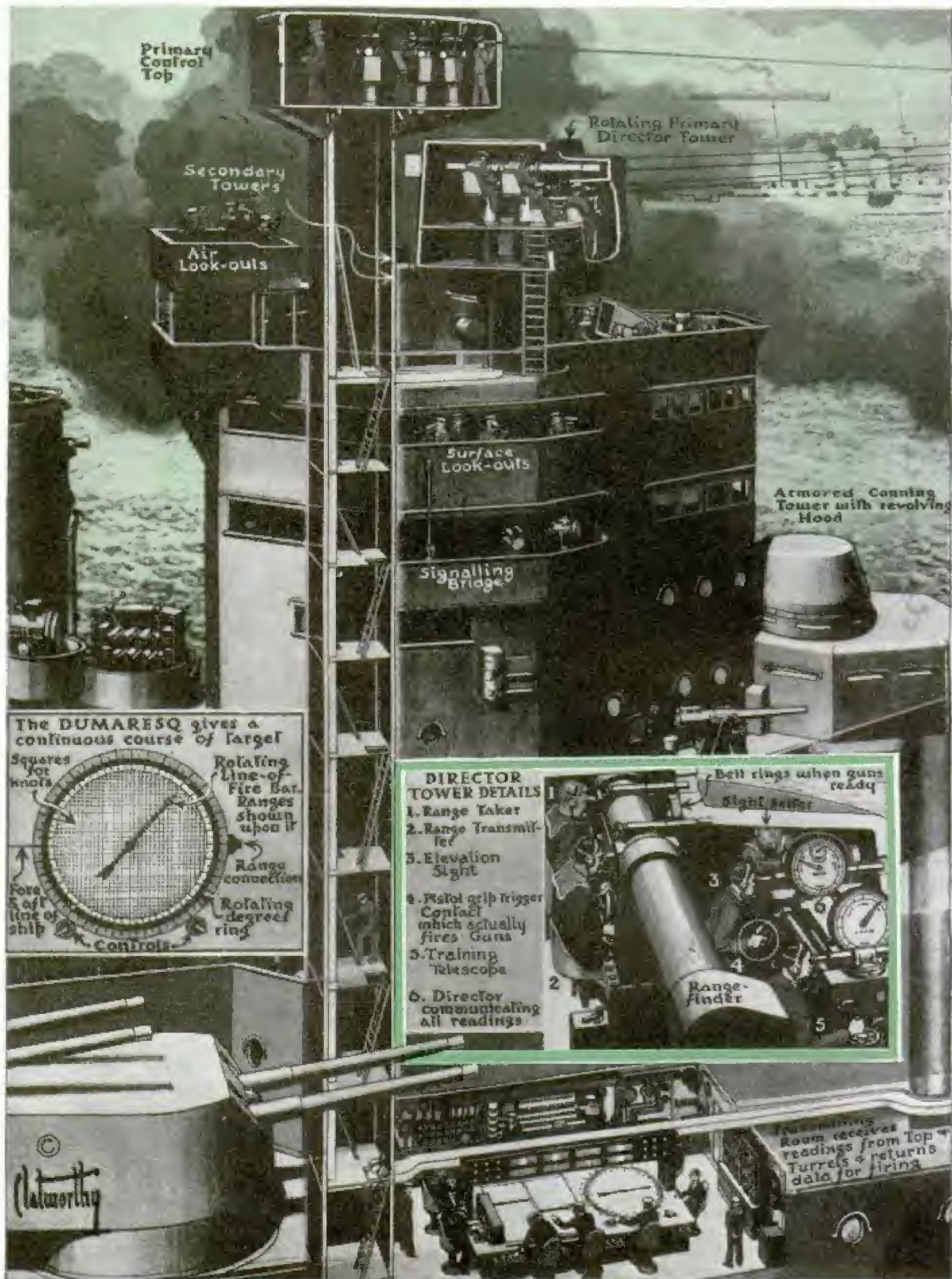
Jointed bar adjusts itself to meet bumper heights

Only one driver is needed to handle two cars with a new towing bar that attaches to the bumpers without the use of tools. Adjusting itself automatically to bumper heights, the bar is fastened easily by turning hand wheels to tighten the clamps, and it can be released quickly by pressing a thumb lever. The clamp jaws are lined with special fabric so they will not mar the bumper finish.

Send stamped, addressed envelope to our Bureau of Information for name of maker of any device described in this magazine.

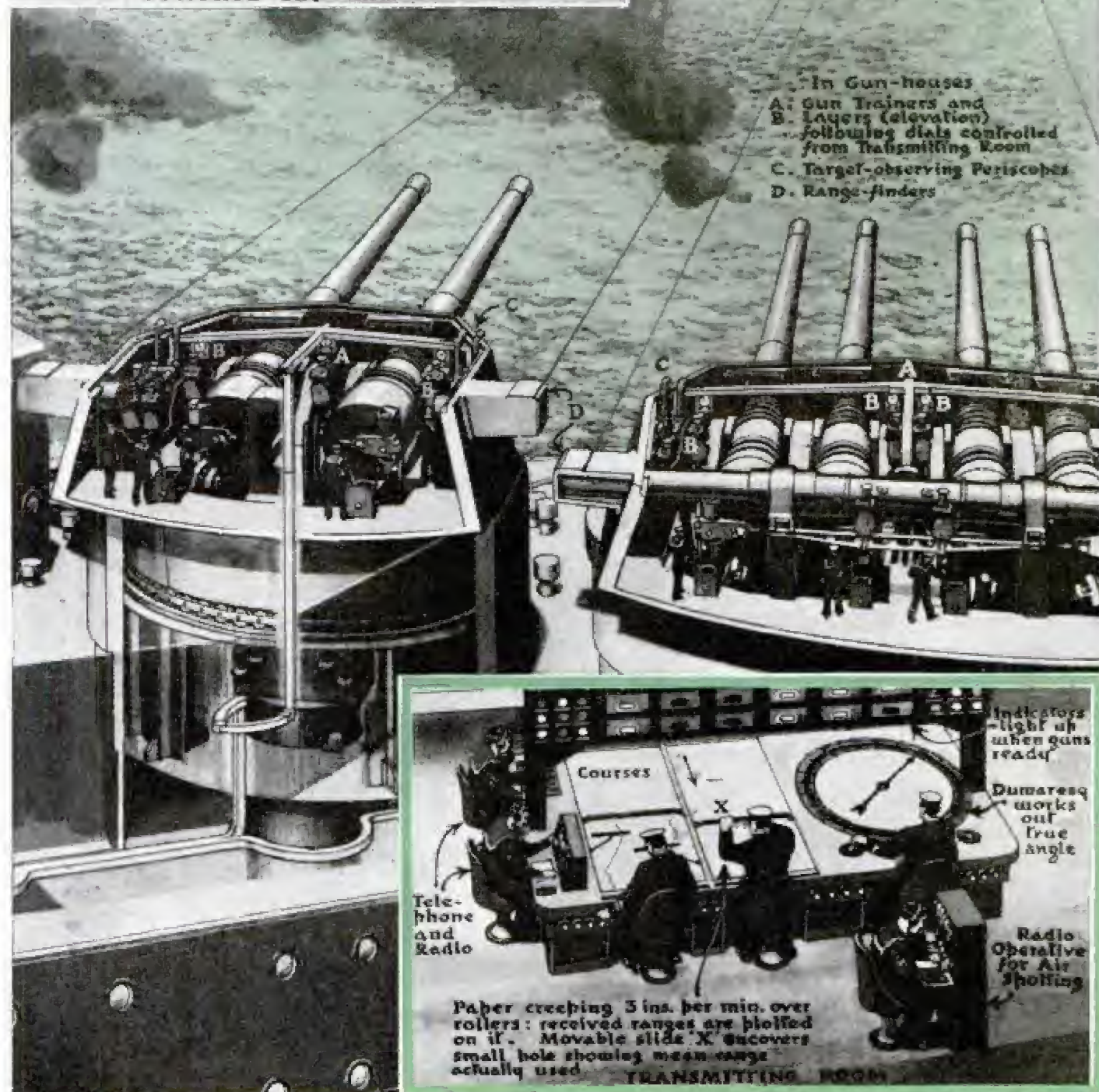
R476
 D. W. Clatworthy & Co., Ltd., London & W. 16 England
 84, Levis Road,

Fire-Control Tower Is the Battleship's 'Brain'



Here is a glimpse of the fire-control tower of the latest British battleships, representing equipment costing about \$1,000,000. The transmitting room, "brain center," is beneath the thickest deck and behind the heaviest side armor. The "Dumaresq" is a mathematical marvel for aiming at moving target

Training the Big Guns of a Floating Fortress



Gun turrets of a dreadnaught are trained on but one target at a time, and gun crews do not see enemy nor even fire their own guns. This is done by electric pistol in director tower after data on range and elevation are worked out in transmitting room. Entire fire-control system is duplicated aft

Elephant Feet Form the Legs of a Sportsman's Novel Table



At left is a wastebasket made of hollowed leg of an elephant, at right a heavy table is supported by two elephant legs

Elephants' feet can be turned into novel furniture for the big game hunter's home or the sportsmen's club. Two huge feet were used as pedestals for a table, and another was hollowed out and mounted as a wastebasket. Smaller elephants' feet were made into decanters.

Rapid Fall with a Parachute Has Little Effect on Man

It doesn't take a superman to jump from a plane, fall through space at 119 miles an hour and land conscious and ready to fight. Aviation physicians have found that a free fall damages neither body nor mind. At high altitudes the sensation is one of floating, gravity-free, in the air rather than plunging downward. There is no terrific strain on heart, blood vessels, breathing, nor on the eyes and ears. The principal annoyance is the increasing pressure on the

ear drums which is compensated by holding the nose and blowing into it. The two real hazards are the two stops—first when the rip-cord is pulled and the parachute gives a stiff jerk which, opened at 325 miles an hour, would exert 6,000 pounds pressure on the chute and the man in harness; and secondly, when the jumper hits the ground. The trick is to come down ready for a forward somersault, but many jumpers are hurt when they land, or are dragged by the chute in the ground wind. The parachute jumper can see clearly even when his eyes are unprotected by goggles, and breathing is normal—why, science has not yet decided.

Electric Model of Element Shows Nuclear Changes

To illustrate the transmutation of elements, eighteen-year-old Robert Tedeschi, science student in a Long Island high school, worked out an electrical model using light bulbs for an illuminated diagram. When he presses buttons, relays of bulbs are lighted, showing what nuclear changes take place as gases change form.



Planting lights in model showing transmutation of elements

Radio Headlight to Prevent Collisions in Air



Aeronautical engineers are developing a radio "headlight," a directional signal projected from an airplane which will permit the pilots to "see" each other at night and in thick weather. Whenever another plane comes within range, a signal on the instrument board will show a warning light and the flier can then communicate with the other ship and avert a collision. There is no immediate need for such a detector, but with air traffic rapidly thickening and around thirty transports flying each way daily between Chicago and New York, a radio headlight may soon become an essential safety device. Air-line pilots today can talk to ground stations, but not to each other in the air. The first step toward an anti-collision beam is expected to be standardization of equipment for inter-plane conversation over fifty to sixty miles. The next step would be an oscillator giving out a

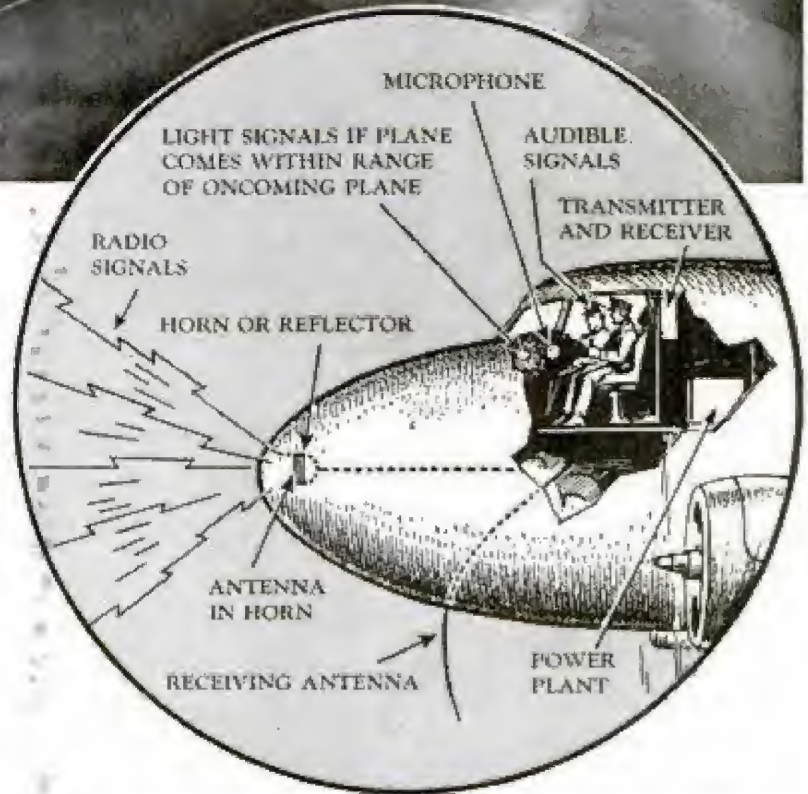


Photo-drawing indicates how planes fifty or sixty miles apart could detect each other; below, diagram of radio "headlight"

signal at intervals, and a visual signal in the cockpit to indicate approach of another plane. Eventually the engineers expect to build a small reflector in the nose of the plane to project a directional, flattened radio beam, divorcing the interphone system from the anti-collision device.

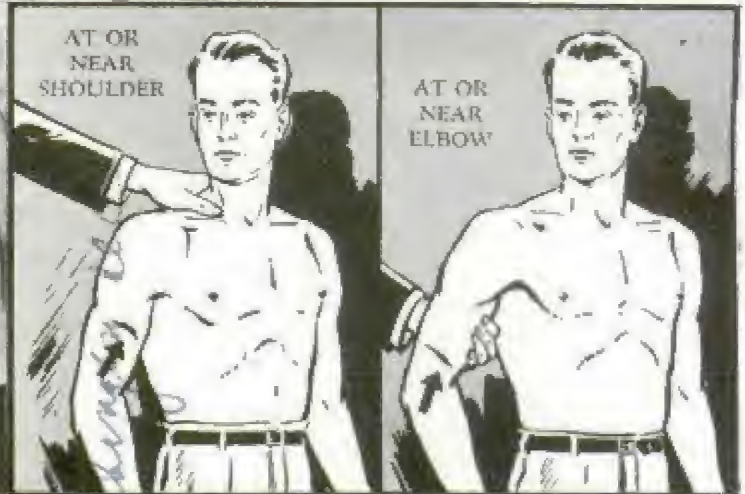
Pliers Cut Metal Armor from Cable and Strip Insulation Off Wires



Pliers cut flexible cable without damaging wires

Flexible electric cable is severed quickly with a pocket-size cutting tool that also strips insulation from the wires. The twelve-ounce pliers will not cause shorts by nicking or bending the wires, according to the manufacturer, and they can be used to cut into the cable anywhere along its length to make openings for outlets, switches or boxes. The blade is removable for sharpening or replacement.

MINUTES



By **Laurance M. Thompson, M. D.**
Assistant Director of First Aid and
Life Saving, American Red Cross

ACCIDENTS happen too swiftly to do anything about them. After they have happened, after a person has been injured, the first few minutes are important. What we do then, or fail to do, often spells the difference between life and death.

Invariably the first thing to do is call a doctor or ambulance. But even in a city, where professional help is never far away, several minutes must elapse before it can arrive. In those few minutes a person can suffocate, bleed to death, die of poisoning or shock. These are the minutes that mean eternity.

In case of an auto accident or fall, where serious injury is apparent or suspected, never under any circumstances move the victim, nor permit anyone not skilled in first aid to do so. He may have a serious fracture. Let him lie in the middle of a busy street if that is where he happens to be, and resist all efforts of ignorant bystanders to bundle him into a car.

The victim might have a broken back or neck. You have no way of knowing. Such injuries, serious as they are, are not necessarily fatal; but easily can be made so by unskilled efforts.

Other fractures may result in

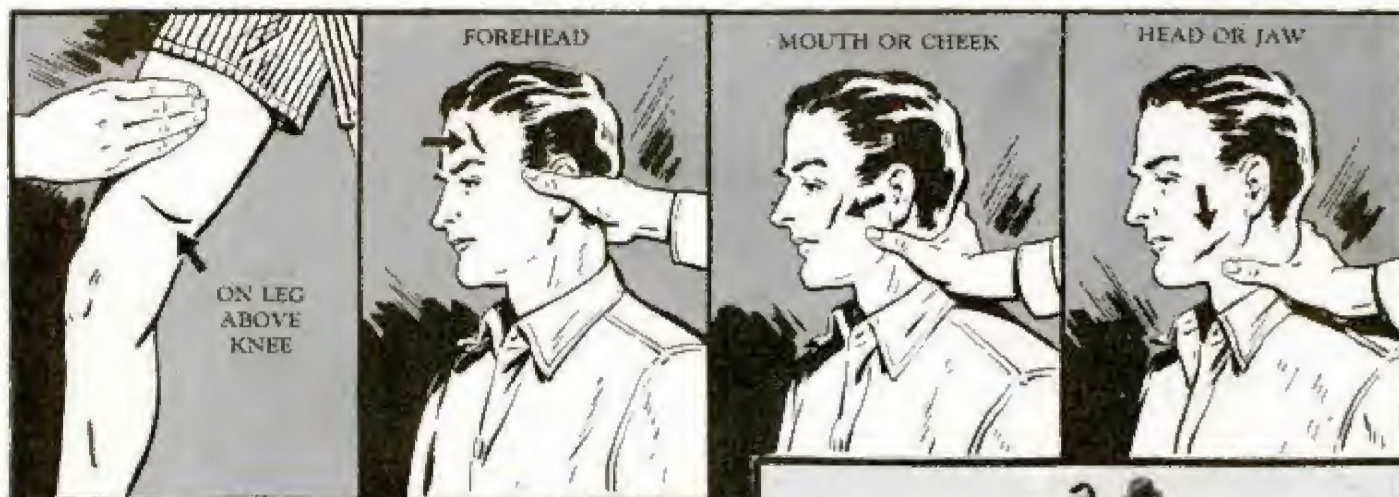


Here are some methods of stopping loss of blood in emergency. At top, using forearm to apply pressure to arm; center, tourniquet applied without pad; bottom, pressing fingers into arm. Drawings across top indicate pressure points for arteries

Cont. Herbert V. Webb, 4322 Second Road North, Arlington, Va.

K 154

that mean ETERNITY



death or permanent crippling if not handled properly. Sharp ends of the broken bone have a nasty habit of cutting through blood vessels, or piercing the skin so that infection results and amputation becomes necessary. Broken ribs can puncture the lungs easily and cause death. If in doubt as to whether bones have been fractured, always assume that they have. Make the victim comfortable, treat for any shock that may be present, but do not move the person until the fracture is splinted.

But one who applies splints must know how. He cannot know without proper training. Such training is available to all,



Above, lowering an injured person from roof. He is strapped to a ladder and his hands are tied to prevent struggle which might cause a fall. At left, the "chair carry," a method which helps avoid dangerous tension on victim's body

Argonne F. Thuchman
children etc
Argonne
W maffel



without charge, at the local Red Cross chapter. Over two million persons have availed themselves of this opportunity. It is impossible to estimate how many thousands of lives they have saved.

Broken bones can wait for skilled attention. Bleeding can not; nor can shock, which is always more or less present in all accidents.

A person may bleed to death from a severed artery in a very few minutes. In all cases of serious bleeding think first of pressure. Press with the fingers between wound



and heart until the flow of blood stops. There are certain places where the arteries cross bones near the surface. Once one has learned the location of these, he can immediately control bleeding from an injury to any part of the body. These places are known as pressure points. In the excitement following an accident, these pressure points may be hard to find in a hurry. You can learn definitely where they are at your Red Cross first-aid class, then practice until you can apply this pressure instantly. You may save a life, perhaps the life of a loved one.

Severe bleeding can be controlled by a tourniquet, leaving the hands free to help otherwise; but

a tourniquet is such a dangerous device in the hands of an untrained man that its use is not recommended except in extreme cases. If one must be applied, let it be a stocking, scarf, or some other wide, soft material. Loosen it gently every fifteen minutes to permit blood to flow to the limb, and stand by to inform the doctor of its presence. Never conceal it with a splint or bandage. Im-



Top, applying a broom splint to arm. A folded magazine may serve well as an emergency splint, center. Bottom, a wife finds husband in garage filled with smoke and fumes; what she does in next few minutes may mean life or death to him

properly applied tourniquets have too often caused unnecessary amputations.

Shock is always more or less present in cases of severe bleeding or extreme pain; and since this condition often causes death even when the injury is not otherwise serious, it should receive prompt attention as soon as the bleeding is controlled.

The symptoms of shock are paleness with an anxious expression. A cold perspiration appears on forehead and palms, the pulse is rapid and weak. The breathing is irregular. Sometimes a severe chill develops; nausea and vomiting are frequent. The victim, though conscious, is mentally dull, and sometimes has to be asked how he feels two or three times, then often replies that he is cold or very tired.

The most important thing in treating shock is to keep the victim warm. Wrap him in blankets, coats, or whatever is handy, under him as well as over. If possible, apply external heat such as hot-water bottles, heated bricks wrapped to prevent burning, or anything that is available. Rubbing the limbs is of little value, since it requires uncovering the patient.

Since the cause of shock is insufficient supply of blood to the brain and heart, the position of the patient is of next importance. He should be made to lie down without a pillow under his head, while the feet, legs, and thighs are elevated. Do not permit him to sit up, except in cases of chest injuries where breathing becomes difficult when lying down. If there are head injuries, have him lie flat but do not raise his feet.

Stimulants may be given, though they are of less importance than heat and position. The best stimulant is a teaspoonful of aromatic spirits of ammonia in half a glass of water. Hot coffee and tea are also good. Give these with a spoon, or have the victim drink a sip at a time, with a few seconds between each to swallow. Alcoholic drinks are depressants, not stimulants, and should not be given. No stimulant should be administered until bleeding has been checked; and an unconscious person should never be given anything to drink, for he cannot swallow.

When a person has taken poison, immediate action is demanded. The treatment is to dilute the poison and wash it from the stomach. Both may be accomplished at the same time by having the victim swallow

(Continued to page 134A)

AUGUST, 1940

Cultivator Turns the Lawn into a Vegetable Bed

"Walking" cultivator used in England to convert private lawns into gardens for raising vegetables in war campaign



Many lawns in England are being dug up and vegetables now grow in place of grass, as part of the home front's drive to win the war. In cooperation with its citizens, the city of Wimbledon owns a small-size power cultivator which is loaned to anyone who wants to help in the campaign to "dig for victory."

Soldier "Sculptured" in Oil Cans Stops Motorists for Gas

In front of a filling station stands a tin soldier with his hand upraised in a silent command for passing motorists to stop. Close by is a "field gun" trained on the road. The entire display, modeled from discarded oil containers, is an advertising stunt to attract customers.



Tin soldier alongside cannon helps sell gas and oil

plane's standard service station

Jig Saw Run by Foot Power Clamps on Bench or Table



Jig-saw craftsman supplies own power by pressing treadle to pull blade downward; spring draws it up

Where no electric power is available, a foot-operated jig saw can be clamped easily to the edge of a table or workbench. Pressure on the treadle delivers power directly to the saw, which is sturdily constructed of cast iron and steel.

'Stop-and-Go' Lights for Speakers Halt Long-Winded Talks



Enforcing a six-minute time limit upon long-winded after-dinner speakers was solved at one club by installing warning lights. Placed at the back of the room, where only the speaker sees it, the signal consists of a buzzer and three colored lights—green, orange and red. At

the beginning of a speech a member turns the big dial to start the timer. The green light at the top shows for five minutes, followed by the orange light for one minute, to complete the allotted six minutes. Then the red light comes on, warning the speaker that his time is up, but allowing him thirty seconds of grace. If this still does not stop him, a loud buzzer goes into action, hindering further attempts of the speaker to make himself heard.

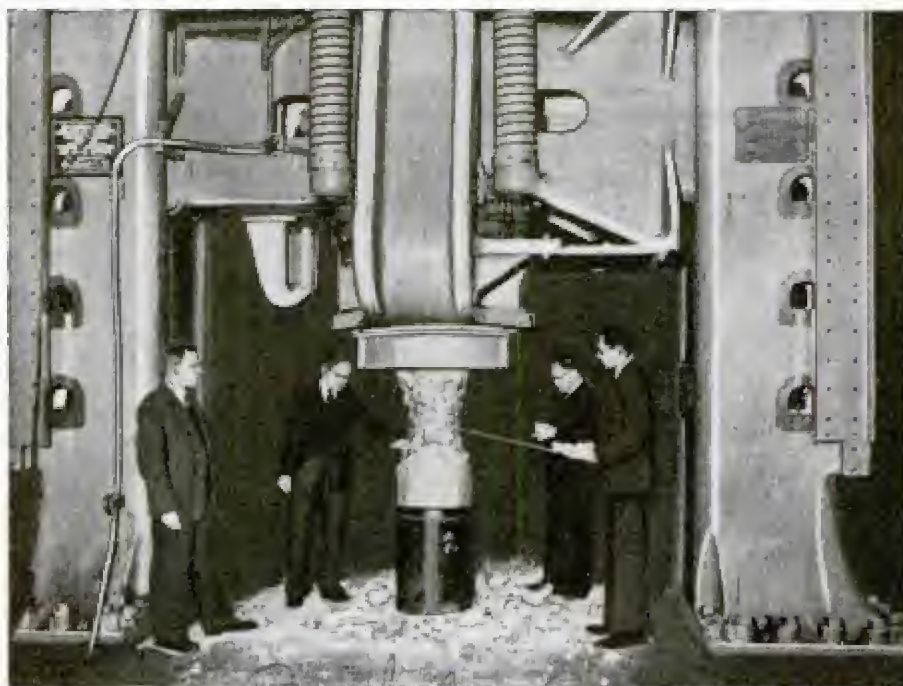
Secret "Peephole" Reveals Caller before Door Is Opened

For protection against intruders who ring the doorbell and force their way into the home when the door is opened, the housewife can have a "one-way" glass window installed in the door panel to permit a secret view of visitors before deciding to admit them. It consists of a bull's-eye mounted in the center of an innocent appearing door knocker. You can look through it from within to scrutinize the stranger knocking at your door, but the person outside is unable to peer in and so would be unaware of the inspection.

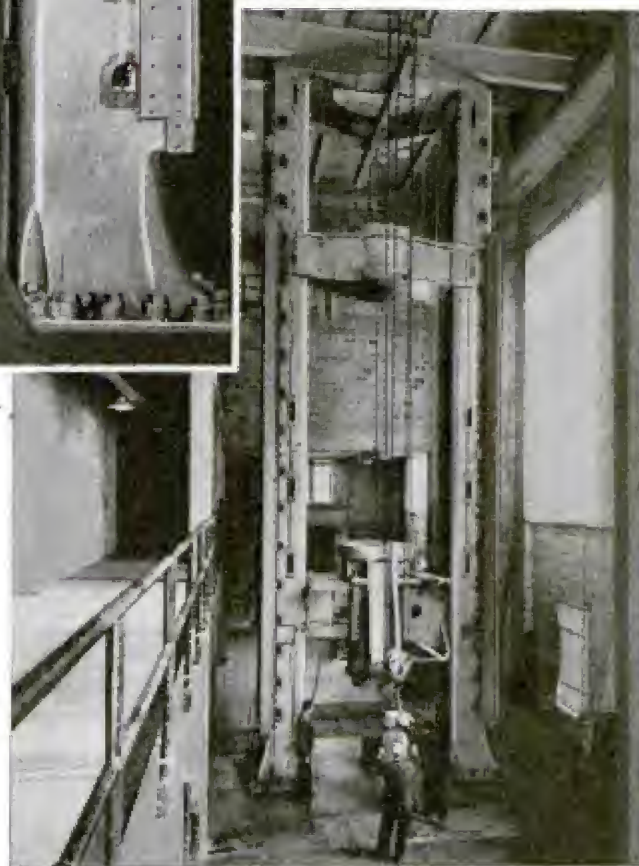


Housewife gets close view of stranger through "one-way" glass in knocker (inset) before opening door

4,000,000-Pound Test Rack Crushes Concrete



At the left, a concrete column is crumbling under the pressure of the hydraulic tester which can exert a 4,000,000-pound thrust. Below, a view of the twin sixty-foot steel pillars, between them the hydraulic steel blocks which put building materials to breakdown test



Huge steel girders buckle and tear apart, solid concrete crumbles under the power of a giant machine at the University of California which puts building materials to the breakdown test before they can be used in dam or bridge or skyscraper. The shoulders of this 240-ton tester consist of two perpendicular steel pillars sixty feet high; between them are two hydraulic steel blocks with 4,000,000 pounds compressive power or 3,000,000 pounds pull. They can tear apart a solid steel bar eight inches thick. Samples of concrete going into Boulder, Bonneville and other dams are compressed until they disintegrate while engineers watch the fracture point. Some of the heaviest steel sections ever used in

construction, like those supporting the San Francisco-Oakland bay bridge, have been pulled and compressed to determine what load they can carry.

Gas-Driven Chair for Invalid Runs Twenty Miles an Hour



Automobile chair for invalids has speed of twenty miles an hour and runs 100 miles on a gallon of gas

One of the latest aids for invalids and aged people is a motorized chair easy to operate. Its two-horsepower engine runs 100 miles on a gallon of gasoline and can drive the car at twenty miles per hour. Equipment includes an electric starter, electric lights and a horn.

First new species of bird discovered in the United States since 1919, a small warbler with an olive yellow patch on its back and raw sienna tinge on the throat was found in West Virginia recently by Karl W. Haller of Bethany college, and named Sutton's Warbler.

HOMING PIGEONS



FROM the darkness surrounding the pigeon lofts at Fort Monmouth, N. J., a bell tinkles. An attendant hurries with a flashlight to remove from the leg capsule of a newly arrived bird a message highly important to the U. S. Army Signal Corps. It reveals that the pigeon was released sixty miles away less than two hours ago.

In quick succession, six other pigeons swoop out of the night sky to the lofts, concluding the same trip. And the Signal Corps has completed another successful experiment in an almost revolutionary effort to develop night-flying birds.

Pigeons have been used since ancient times as message carriers, but only in daylight hours, because it is unnatural for them to fly at night. Daytime use of pigeons has always been undesirable, from a military standpoint, because the birds frequently were brought down or wounded by enemy sharpshooters, and messages fell into the wrong hands or were lost. Too, pigeons were subject to attack by natural enemies, such as hawks, increasing the

Photos courtesy U. S. Army Signal Corps

Top, left, removing message from pigeon's leg. Right, releasing bird for night. Bottom, kind treatment is important in training the pigeons

on the NIGHT SHIFT



chances against messages reaching destination.

Just recently the Signal Corps began trying to invert the habits and instincts of pigeons by training them to fly at night. One of the first discoveries was that not all pigeons are adaptable to this work. Hating night flying naturally, the average bird will not get into the air, but will land as soon as he sees an opening. Of course, birds that will not get into the air are never of value, for eventually they are certain to fly into wires or trees and injure themselves. Therefore, it has been necessary to select birds of superior intelligence and courage for night work.

Long hours and plenty of patience are requisites for the trainer. Flying at night is a quality that may be developed



Top, left, placing metal band on six-day-old bird. Right, inserting message into harness-type tube. Below, pigeons homing to mobile loft after a move. Left, releasing winged messengers



in an individual pigeon, but it is not transmitted to the youngsters, so each bird must be trained.

When the Signal Corps experiments began, the loft was brightly illuminated. Later, colored lights were tried and finally all lights were removed. The birds, it was found, fly as well to a dark loft as they did to one well lighted. Numerous attempts were necessary before the pigeons started returning to the loft from the point of release, a short distance away. Gradually the distance was increased until today the workable average is about twenty miles. However, the successful experiment covering nearly sixty miles is regarded as evidence that the birds soon will be able to fly reasonably long distances without

becoming lost or injuring themselves. On that, the longest night flight attempted, the pigeons were released at 11:55 p.m., on a dark night, in a slight drizzle of rain.

Another discovery made during the Signal Corps experiments is that the birds, because they do not like to fly at night, even though they have had years of training, always fly much faster than they would during the day. As a result, it is not uncommon to get speeds far in excess of a mile a minute at night. Average daylight speed is about thirty-five miles per hour, although speeds about twice that have been recorded under favorable conditions.

Training methods have changed greatly in the past few years. Where previously the birds were controlled by use of their instinctive return to the mate, and by starvation—forcing them to return to the loft for food—now they are trained through kindness. Believing that the homing pigeon was intelligent enough to do anything required of it, if it were shown



Top, on their way with important messages. Center, bandaging leg of injured bird. Bottom, returning to home loft after a practice flight in Hawaii

what was wanted, a training method was inaugurated to make the bird perfectly contented in the loft and to impress on it what was expected of it outside the loft. Results have been surprising. It is now possible to move a loft mounted on wheels into new positions, many miles away, and break the birds to a new location within twenty-four hours without having any of them fly back to the old location. It takes little imagination to recognize the value of this training to an army in the field.

In the Fort Monmouth lofts 500 of the finest pigeons in the United States are housed. Here are bred replacement stock for the other army lofts and for the mobile lofts. When the youngsters are six days old a seamless metal band is placed on their legs. This band shows where the bird belongs, when it was hatched and gives the bird a permanent serial number.

Young birds are taken from their parents when four weeks old and placed in lofts by themselves. Their first training consists of being placed on the loft landing board for a look at the country. As the birds grow stronger, they are taken from the loft, starting at only a few feet, and forced to fly back. At this time they are also trained to enter the loft when called. This is done by repeating a sound at feeding time until the birds associate that sound with "mess call" and will dash into the loft whenever they hear it.

Later the pigeons are equipped with leg or back capsule. All are trained to carry these tiny tubes so that they will not fight them when taken into the field for use. The tube on the leg is very light and the messages are written on thin paper so there is very little weight. The back capsule, designed for carrying maps and photographs, is held in place by a harness. Each bird has to be fitted for this harness, to insure that it will fit properly and that the capsule is balanced on the bird's back. Loads of as much as three ounces have been carried successfully in this manner.

The mobile loft, converted from a standard house trailer, becomes the permanent home of the birds placed in it. They are allowed to mate and breed in this loft. It is moved by being attached to a truck and towed. During preliminary training the loft is moved every day so that the birds become accustomed to looking for it, and no difficulty is experienced in making

(Continued to page 127A)

AUGUST, 1940

Vacuum Cleaner Run by Air Handy at Service Station



Handy vacuum cleaner for service stations operates on compressed air and produces a strong suction

Producing a stronger suction than many electric-motor vacuum cleaners, a new machine operated by compressed air is designed for use at service stations. Its suction increases as air pressure is applied.

K 53 2

Powered Lightweight Chain Saw Can Operate under Water

Working efficiently both above and below water, a chain saw is adaptable for use with gasoline engine, electric motor or pneumatic power units. Lightweight and portable, the amphibious saw cuts off piles under water, fells trees on land, and saves labor in cutting up large logs or lumber.



Cutting a log with the power driven chain saw

Moell Tool Co
7740
Chicago
251

Ser. Vac. drive.
247
23
Los Angeles Calif

Chicago

TRAPPERS



Peering into a cathode-ray oscillograph, engineer above watches path of sixty-kilovolt artificial lightning stroke through lightning arrester. Lightning flashes up to 3,000,000 volts surge between spheres at right



HURLED with the terrific energy of a thirty-pound shell fired from a cannon at a muzzle velocity of 2,200 feet a second, a bolt of lightning strikes a power line carrying electric current to a near-by house. Within a split second five, six or more destructive lightning "shells" have scored direct hits upon the pole supporting the power line. Strangely enough, nothing happens. Because the modern trappers of lightning have done their work well, lights in the house do not even flicker.

With from ten to fifty million lightning bolts bombarding the earth every year, the average thunderstorm up to a short time ago meant possible trouble if not danger for communities throughout the country. A housewife working in her kitchen, a factory hand bending over his lathe, a surgeon performing an emergency operation—in fact millions of people in all walks of life were likely to have their activities

halted, sometimes under hazardous circumstances, by a bolt of lightning disabling an exposed line and depriving them of needed light and power.

Today scientists have taken many of the risks out of nature's fireworks by actually trapping wild lightning bolts, the biggest and most treacherous of all big game. Research engineers learned to duplicate them in laboratories with man-made apparatus, study their characteristics and devise safeguards against their menace. They have even put up lightning bolts in "packages" for use in testing safety devices.

"A strange phenomenon is natural lightning, and stranger still is the modern research engineer's efforts to duplicate and study it," says Peter L. Bellaschi, research engineer of the Westinghouse Lightning Laboratories, Sharon, Pa., one of the greatest lightning trappers.

"Not only is lightning the most awesome

of LIGHTNING



Engineers say natural lightning (top) hits earth ten to fifty million times a year. Right, half-million-volt static charge stands girl's hair on end. Below, lights stay on in toy house as 3,000,000-volt stroke detours from transformer to ground

of nature's spectacles but it is also one of the most variable. There are countless stories regarding the unpredictability of lightning and where and how it will distribute its four destructive characteristics—explosion, burning, paralyzing and contortion.

"The pressure and heat of a lightning bolt shatter trees, poles and metal pipes by converting their particles of matter into gases in a few millionths of a second. Expansion of gas does the rest.

"Contortion of tin roofs on barns, for instance, is due to the magnetic force of the lightning. The metal is twisted and curled by the magnetic field set up by the high-current concentration through the metal conductor.

"Innumerable stories of lightning burns and paralysis, frequently fatal, are reported every year. Animals need not be struck by lightning to be killed by it.



Developed by Westinghouse for High Voltage Laboratory



Whole herds of cattle are known to have been killed while grazing thirty feet from a tree struck by lightning. The lightning current flowed radially out from the tree, producing high-voltage bolts between points on the ground which were bridged by the bodies of cows."

To devise safeguards against lightning, scientists needed as much data as possible about its characteristics. But while it was possible to study lightning by photographing it and by measuring its strokes and effects with an expensive apparatus known as the cathode-ray oscillograph—research

work which Westinghouse began thirteen years ago—this meant being lucky enough to be in the right place at the right time to observe the bolts. What science needed was some small apparatus which could be spotted throughout the country to record lightning automatically.

It came in 1939, a development by Charles F. Wagner, Westinghouse consulting engineer at East Pittsburgh, Pa. Mr. Wagner, in charge of Westinghouse investigations of natural lightning, explains:

"The device is called the ful-chronograph (lightning-time-write). A small motor drives a recording disk at constant speed. Fixed to the rim of the disk are several hundred flat strips of magnetic material. At one point the rim of the wheel passes through a field of a coil. A lightning surge is led through this coil to ground, creating a magnetic field across



Cathode-ray oscillograph, top, uses beam of electrons as pencil moving 1,000 miles a second to trace electric voltages on photo film. Lower left, engineer presses button to release lightning from surge generator. Right, porcelain lightning arrester that discharged 21,000-ampere current of direct stroke

the recorder rim whose magnitude varies with the change in current during the life of the stroke. Each tiny magnet thereupon receives a magnetic charge, proportional to the current in the surge at the time that magnet is swung through the lightning-produced field.

"By measuring the strength of the magnets thus formed, and knowing the speed of the disk, a current-time curve of the lightning stroke can be plotted. Such records show current magnitude, polarity—and very important, the full duration of the current.

"By the onset of the 1939 lightning season about fifty of these 'traps' had been set on all sorts of lightning-exposed structures—radio towers, tall buildings and transmission lines scattered from the Gulf coast to New York. Many

(Continued to page 116A)

Hubert D. McCann



Fulchronograph, left, measured current in bolt striking a skyscraper. Right, (top) space between spheres is adjusted to regulate voltages up to 750,000 in circuit-breaker test; (bottom) checking magnetism in recording wheel of fulchronograph

Lightning Engineer
Cathedral of Learning

AUGUST, 1940

Life-Size "Last Supper" Sculptured in Plastics



"Last Supper" reproduced in plastic figures, right, now being exhibited to accompaniment of descriptive lecture and appropriate music, required ten years to complete and is valued at \$150,000. Above, fastening garments in place on the life-size figure of Jesus



Plastic materials of his own composition, instead of wax, were used by a Hollywood sculptor in creating a life-size reproduction of Leonardo da Vinci's famous painting, "The Last Supper," with amazing fidelity to the color and form portrayed in the original. The features of the sculptured figures are reproduced according to the artist's conception of each character, and such details as clothing and tableware have been copied closely.

Traveling "Auto Doctor" Diagnoses the Ills of Your Car

Believing that automobiles need an impartial doctor to investigate their ills and prescribe a remedy, a Los Angeles expert operates an auto clinic on wheels. For a nominal fee he drives to the garage, home

or parking lot of his patient, and with his carload of instruments will analyze the car's ailments, feeling its "pulse" for tell-tale vibrations, and taking its temperature and pressures in search for symptoms.

The motorist receives a diagnosis as well as a prescription for adjustments and repairs, which he takes to his own repairman or service station. The "doctor" does no repairing himself and will not even recommend anyone to do the work, assuring his customers of an unbiased examination and report. A special service offered to prospective purchasers consists of an accurate appraisal of the value of a used car.



Automobile "doctor," left, applying stethoscope to ailing engine. Right, mobile laboratory carries instruments for diagnosing car's troubles



The CRAFTSMAN

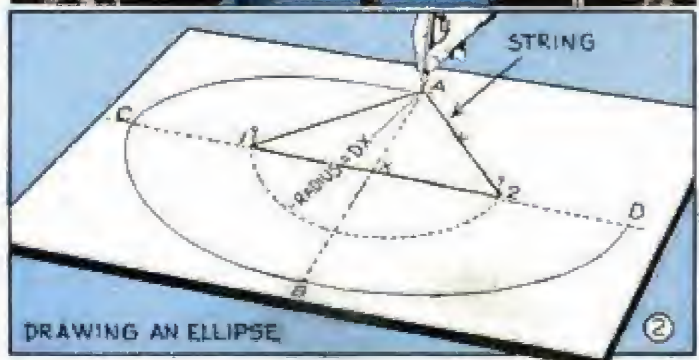
SNACK and BEVERAGE

Tray

cut from plywood

LIGHT lunches at the bridge table can be served conveniently with this little double-deck tray. Cutouts in the upper deck hold beverage glasses securely while carrying the tray. Tidbits and small napkins are placed below. As you see from Fig. 1, nearly all straight lines have been eliminated in the design. The decks are oval in shape and the upright piece which incorporates a handhold, is also pleasingly curved. While a scroll saw is best for the job, the cutting can be done with an ordinary coping saw.

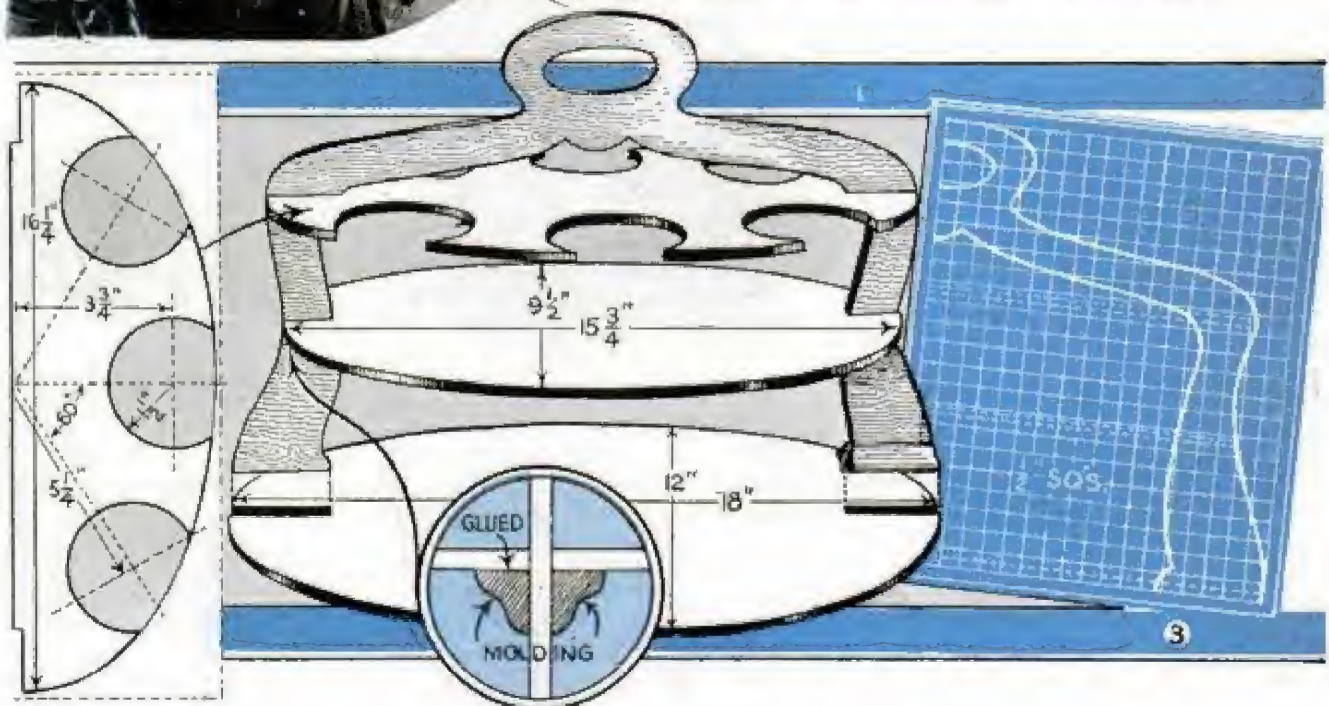
Due to the design of the handle and the cutouts for the glasses, the wood should be $\frac{1}{4}$ -in. plywood. Sizes of all parts are given in Fig. 3 and the method of drawing an ellipse is indicated in Fig. 2, which is done as follows: First divide the length and width of the desired ellipse with centerlines A-B and C-D, which cross at right angles at the center X. Points 1 and 2 where brads or pins are driven are located by striking arcs across the line C-D, using points A or B as a center for the compass and adjusting it so that the radius of the arc scribed will be exactly equal to the distance D-X. Then a loop of string is slipped over the brads and should just reach to





point A or B when stretched to triangular shape by means of a pencil as shown. Then it is a simple matter to draw the ellipse by sliding the pencil point along inside the taut string up to points C and D, and repeating the process on the other side.

The portions of the plywood on which the ellipses are drawn should be separated roughly with a fine hand saw and then the curves are cut with a scroll or coping saw, after which the edges should be sanded carefully, rounding the corners slightly. The design for the handhold is laid out on paper and traced to the wood. A small hole is first bored in the waste portion of the stock to insert the saw blade. After cutting slots at the ends of the elliptical pieces to fit the handle portion snugly, small blocks are glued in the corners as indicated, clamps being used to hold them in position until the glue has dried thoroughly.



Sealing Knots and Stains in Wood to Prevent Bleeding

If knots and resinous or sappy spots, in wood to be painted, are not sealed against bleeding, the paint job is likely to be ruined. For small, smooth knots and resinous spots, two coats of shellac or aluminum paint are usually effective. On large knots where the latter treatment is insufficient, it has been found that Cellophane glued over them will often do the trick. Also, Cellophane is good for tar and other stains in wood or plaster, and for hiding hair cracks and lath marks in plaster that is to be painted or papered. Use a piece of Cellophane larger than the surface to be

covered, dip it in cold water and place it between two pieces of newspaper to absorb surplus water. When applying it to wood, coat the knot or stain with thin glue, place the Cellophane on the tacky surface and smooth it with a piece of cloth, rubbing from the center outward. For applying Cellophane to plaster or painted surfaces, coat the surface with a glue size made by mixing brown sugar, 1 spoonful, and glue, 1 pt. It is not advisable to repair a stain requiring a piece of Cellophane larger than 2 ft. square.—C. A. Graham, Scarboro Bluffs, Ont., Can.

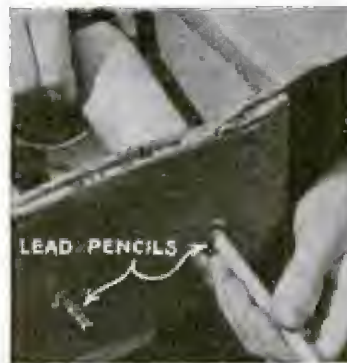
Improvised Holder for Crocheting Materials

Whether you prefer to crochet while riding in the car or sitting in your favorite easy chair, this improvised box will be found ideal for holding your materials. All you need is a couple of lead pencils and a corrugated-cardboard box. Sharpening the pencils will allow them to be punched through the sides of the box easily.

Care of Iron Kettles

Iron kettles should be primed before they are used for cooking. To do this, fill kettle with cold water and let it boil a short time. Then wash and scour it thoroughly, rinse, dry well, and grease it with sweet lard. Next heat it very hot, and wipe off what lard has not been absorbed. Do this a few times before using and you will not be annoyed by rust or a strange taste, provided you keep the kettle perfectly clean and dry when not in use.

—A. W. Scheib, Arlington, Mass.



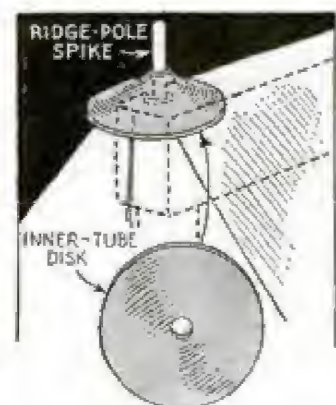
Load Dumped Easily from Wheelbarrow with Hinged Sides



Fit your garden wheelbarrow with sides like the ones shown and you can lower them to make dumping sideways easy, or you can dip them at an angle to increase the load size when hauling light material. The side pieces are mounted on heavy strap hinges and strong hooks engage screw eyes in the end piece of the wheelbarrow to hold them either in a vertical or flared position.—S. A. Camp, Riggins, Ida.

Keeping Rain Out of Tent

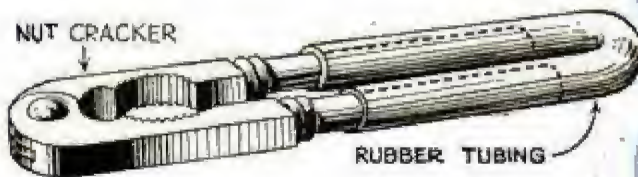
During long, steady rains, water sometimes enters the ridge-pole openings of a tent. To avoid this, cut disks from an inner tube and impale them on the steel spikes that project through the holes.



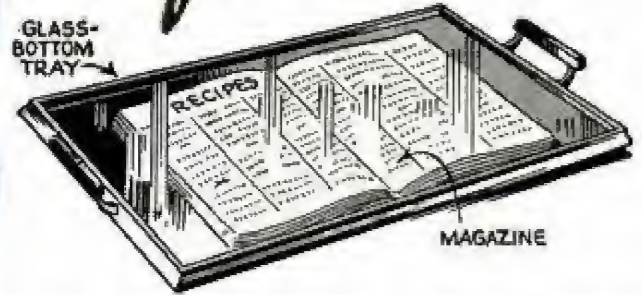
Solving HOME



Fitted to the front legs of a high chair as above, two vacuum cups will help prevent a small child from pushing itself over backward. The cups are attached by drilling tiny holes into the ends of the chair legs and screwing the cup bolts into them



You will find a nutcracker much easier to use if a length of rubber tubing is slipped over the handles as above. The tubing will tend to spread the handles so that they can be operated with one hand. Be sure to allow the tubing to form a loop at the fold so that the handles can be opened wide enough to receive a nut



Soiling of the pages of a cookbook when it is opened on your worktable can be avoided by setting a glass-bottom serving tray, or even a clear-glass baking dish over it as above. The weight of the tray will keep the pages flat. Inserting or removing a pie from an oven is simplified if it is put in a tray made from a cake tin, shown below



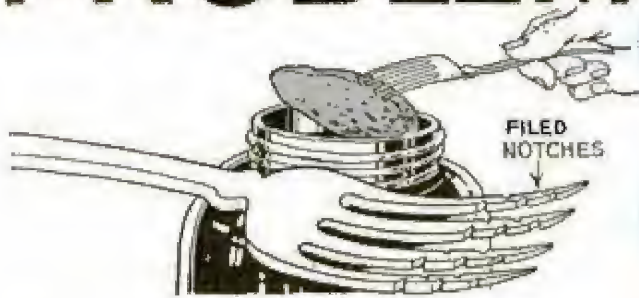
The next time you have to repair a finger in a glove, try using a sewing thimble as a darning egg as indicated below. Slip the thimble on one of your fingers and push it into the glove, pulling the latter down snugly over the thimble



A shelf to hold soap, brushes and other articles is attached easily to your scrubbing pail. A wide board is cut out as indicated at the left, to take a band made from heavy sheet metal, the band being screwed to the board. Small lugs straddle the ears of the pail where the bail is attached. It will be necessary to remove one side of the bail to slip the shelf in place



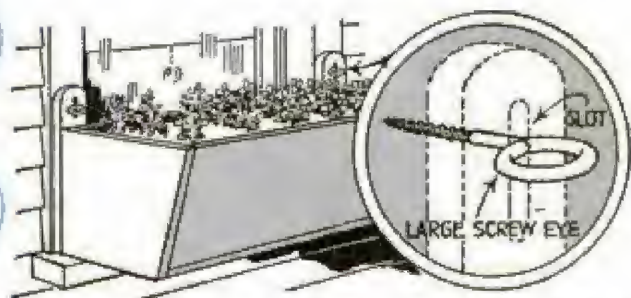
PROBLEMS



An ordinary table fork with notches filed in the tines to provide barbs as above, will remove pickles from a jar without them falling off. If you have small children in your home, you can prevent them from getting at poisons by keeping the latter in the top shelf of the bathroom cabinet and fitting it with a hinged cover that can be closed with a small padlock as at the right

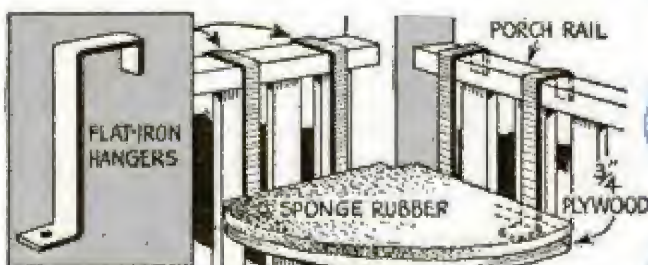


Suspend your porch swing with large eyebolts and rings as shown at the left and it will not squeak. The swing chains are attached to the ring with large S-hooks, which can be obtained at any hardware store



To anchor a window box on the sill so that it is easy to remove, slot a couple of wood cleats to take the heads of screw eyes in the window frame. Nail the cleats to the box, slip the screw heads through the slots and turn them as above

Suspended from the corner of a porch railing, the seat below provides a handy extra "chair" that utilizes waste space. If desired, it can be removed, and set away when not needed. Heavy flat-iron brackets support the seat



The removable shelf at the right permits potted plants to be set on a porch rail to get air and sunlight without any possibility of them being blown or knocked off. The shelf is made from a 10-in. board and is held on the rail by clamps shaped from heavy flat iron. The clamps are bolted to the board so that they slip under the rail



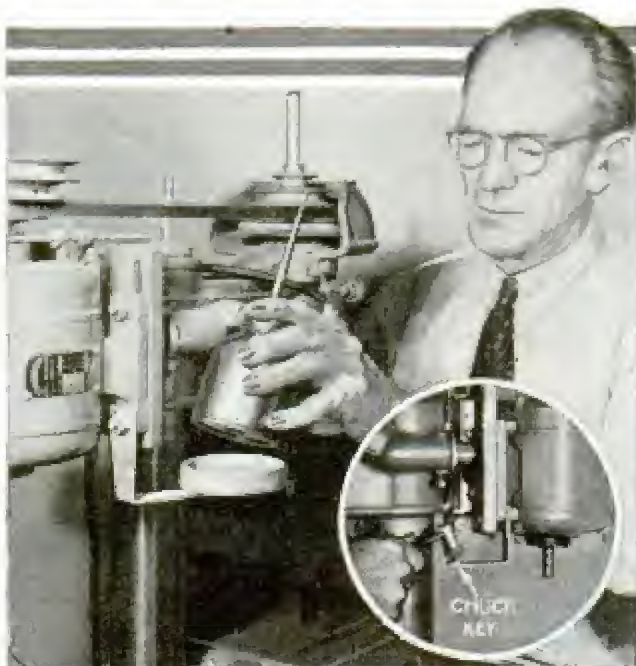
Safety Added to Coaster Wagon by Use of Rubber Bumper



To avoid injuring anyone if he accidentally bumped into them with his coaster wagon, and to cushion the shock if he ran into a solid object, one boy put a rubber bumper on his coaster wagon. This was merely a section of auto tire nailed to the wagon tongue in the position indicated.

Tool Holders on the Drill Press Keep Accessories Handy

The chuck key and oilcan for use in connection with a drill press will always be at hand if you use a couple of holders like the ones shown. A piece of flat iron bent in the center at right angles and screwed to a

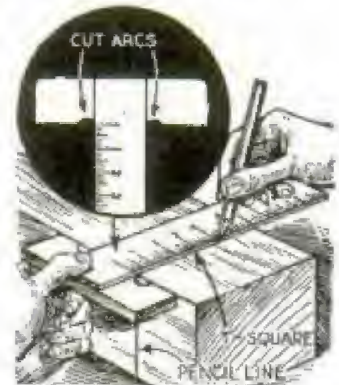


saucer-shaped wood disk will hold the oilcan when attached under a nut on the drill press. The chuck key can be kept in another piece of iron drilled at the end and similarly bent. It is attached under a bolt head on the opposite side.

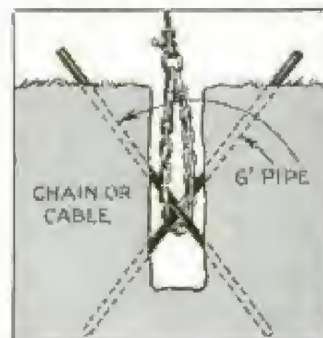
—Frank Hegemeyer, Monterey Park, Calif.

Notches in T-Square Head Make Work Lines Visible

When squaring a board or block on two or more sides, a T-square with semicircular sections cut out of the head, as indicated, will make the guide lines on the work easily visible for comparison.



Method of Rigidly Anchoring Brace and Guy Wires



Whenever you have to anchor a brace or guy wire in the ground, here is a method of doing it that is strong and rigid. Just drill a hole into the ground.

Then, using either a chain or cable to form a loop on the end of the wire, suspend it into the hole and drive iron pipe or rods into the ground at a tangent so that they pass through the loop inside the hole as indicated.

—Chester Jasin, Chicago.

Scrubbing Brush Silks Corn

The tedious job of removing silks and bits of husk from an ear of sweet corn can be done quickly by using a brush. One having stiff fiber bristles, such as used for cleaning pots, is best, and is passed back and forth over the ear parallel with the rows of kernels.

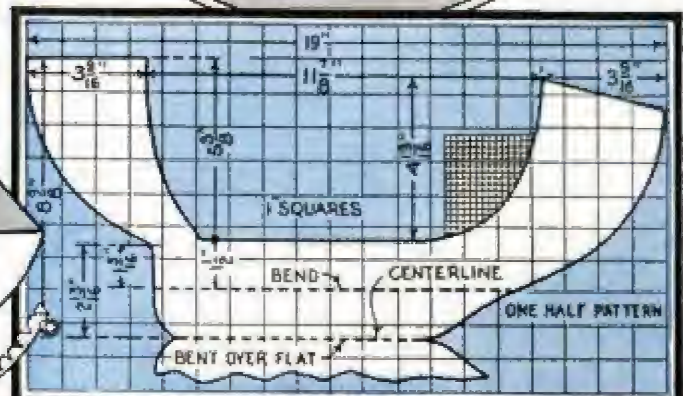
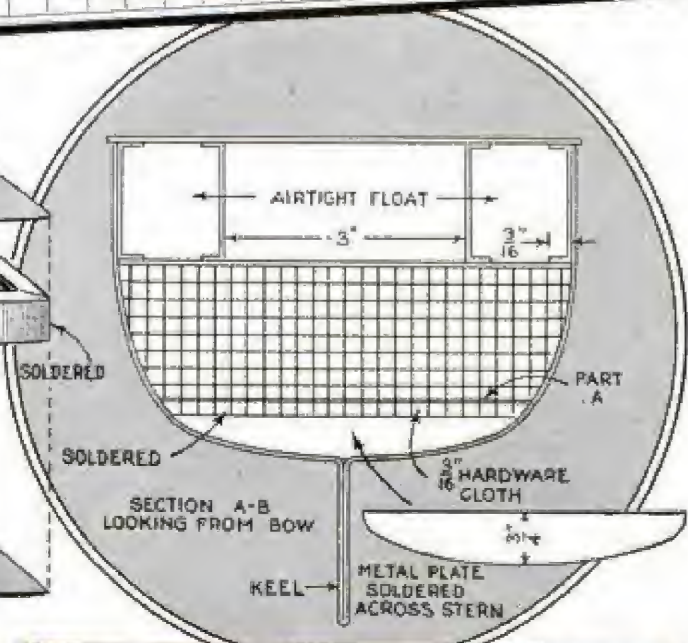
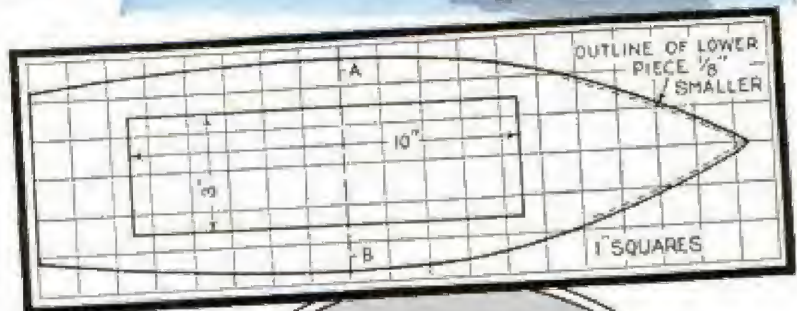
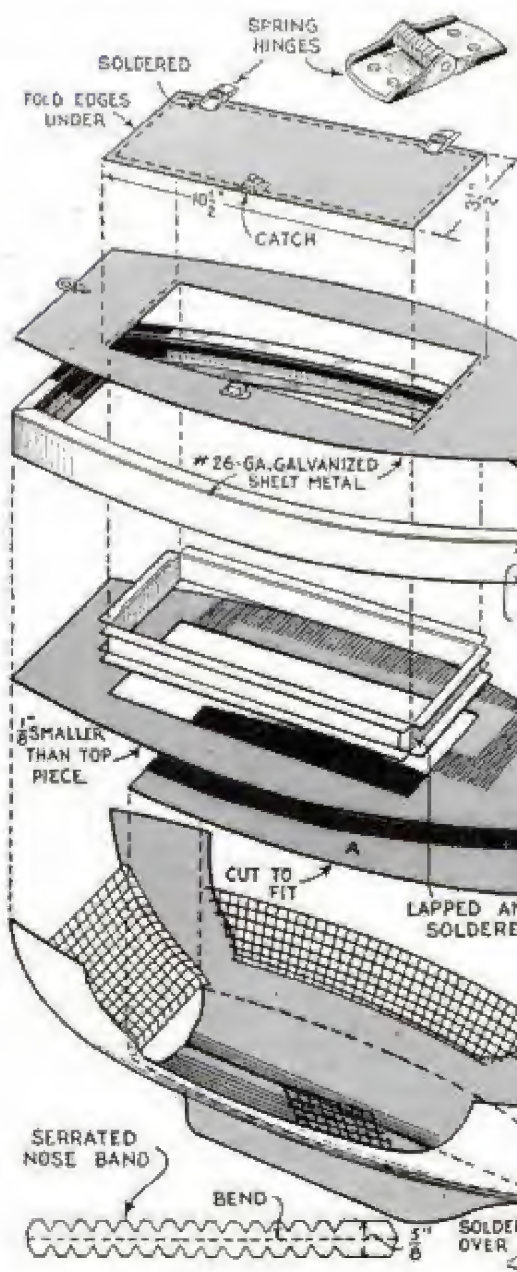


—Ivan J. Stretten, Detroit, Mich.

MINNOW TROW

keeps bait alive

Sheet metal and wire mesh are soldered together to form this handy little minnow trow, which will keep the fisherman's bait alive on the hottest day, when the usual minnow bucket, kept in the boat, would fail. In use, it is towed behind or alongside the boat and causes very little resistance because of its shape, and thus it does not make rowing inconvenient due to drag. The wire-mesh sides permit a constant change of fresh, cool lake or river water, which is the reason for its success. While the details given here were taken from a model that proved entirely satisfactory in actual use, you can make a larger one of similar proportions if desired. Airtight chambers keep it afloat even in rough weather, and as sheet metal is used for construction, the trow should last indefinitely.



Bed Knife of Mower Held Down While Cutting Tough Grass



A simple arrangement to hold the roller and bed knife of your lawnmower to the ground when cutting tough grass can be made with a length of No. 6 wire and a screen-door spring. Hook each end of the wire into a hole in the castings that support the roller and extend it upward behind the handle brackets so that it forms a triangle with its upper corner 6 in. directly above the lower end of the handle. Now attach one end of the spring to this upper corner, which has been indented for the purpose, and extend it downward over the end and along the underside of the handle. Stretch the spring reasonably tight and fasten the end to the handle with a small screw eye.—W. F. Allen, Callao, Mo.

Storing Odd Pieces of Wire



Most of us keep various lengths of insulated wire of all sizes around our homes or workshops, and usually throw them into a box or hang them on nails. Instead of having to untangle the wire every time

a piece is needed, as when it is stored in a box, make spools or reels from paper plates. Place them bottom to bottom and nail them to a wall or cabinet as shown.

Inexpensive Fire Kindler

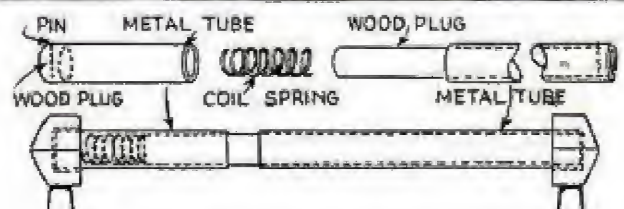
Filled with paraffin, a used shotgun shell makes a handy device for starting a fire when wood is damp. To start a fire, slit the sides of the shell with a knife and ignite the paraffin.



Making a Paper-Towel Rack to Match Other Fixtures

I wanted a paper-towel rack to match other wall fixtures in the room, and as one could not be located in local stores, I made this one. A regular hand-towel rack with a removable rod, like the ones already on the walls of the room, was purchased. The brackets from this were used, and a telescoping rod for easy insertion of the paper roll was assembled from two short pieces of metal tubing, a coil spring and a large wood dowel, as shown in the detail.

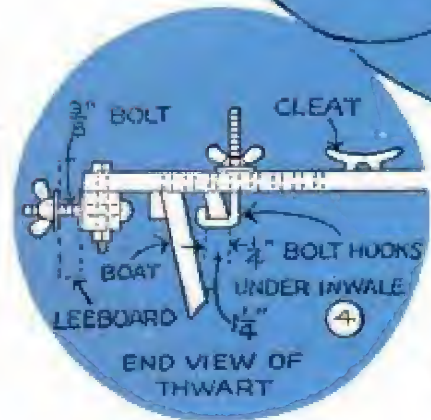
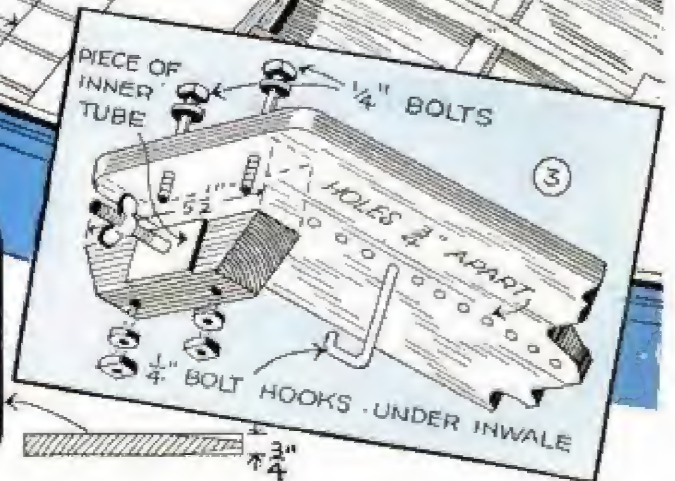
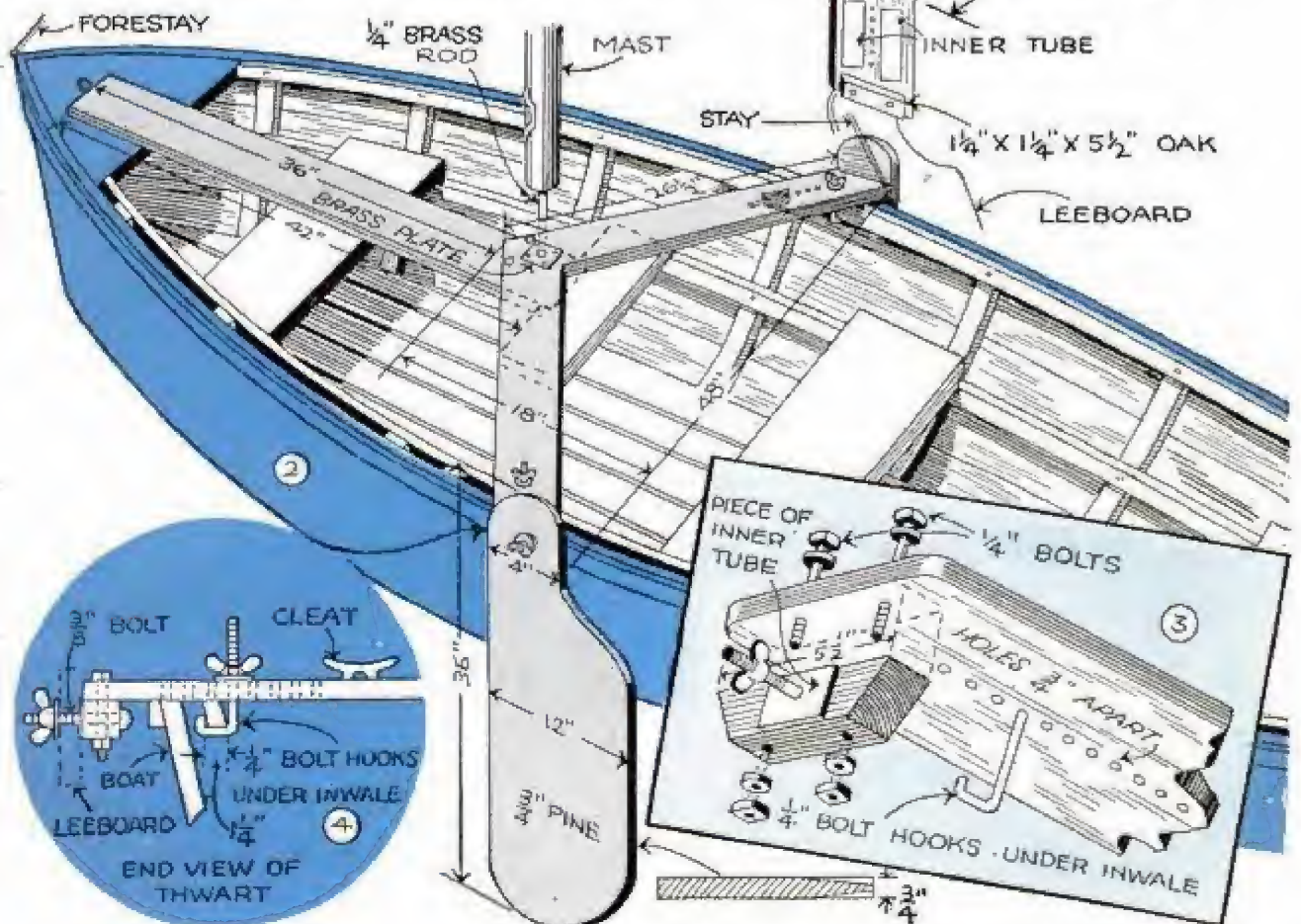
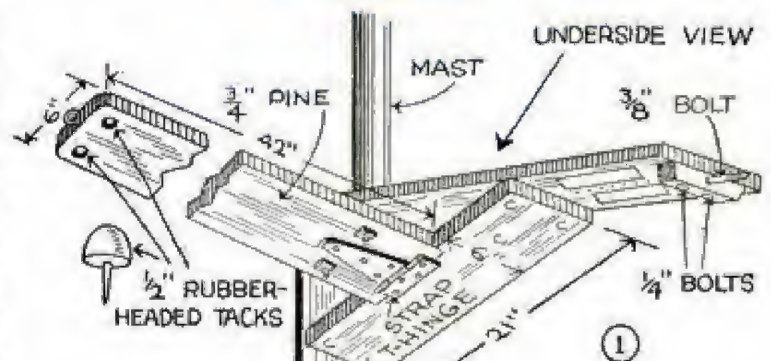
—Merle J. Lucas, Chicago.



A ROWBOAT *goes Sailing*

By David Swartwout

EQUIPPED with this inexpensive portable sail rig any rowboat becomes a sailboat. While dimensions given in Fig. 2 are for a small boat having a beam of 4 ft., the length of the thwart may be varied to suit the boat at hand. With the exception of the rudder and tiller, which should be made of oak, $\frac{3}{4}$ -in. pine will do for the leeboards and thwart. Begin by making the thwart. Two pieces of 6-in. stock, cut to the proper length and mitered $22\frac{1}{2}$ degrees, are held together with a notched cleat fastened to the underside with $1\frac{1}{4}$ -in. brass screws as in Fig. 1. The forward piece which rests on the breast hook, is attached to the thwart with a large T-hinge. The barrel of the hinge should be fitted with a removable pin so that the assembly may be taken apart easily for storing. Two bolts passing through





holes in the peak of the thwart securely clamp the forward member in place. To make the rig adaptable for use on several boats whose beam may vary slightly, a series of $\frac{1}{4}$ -in. holes spaced $\frac{3}{4}$ in. apart, is provided at each end of the thwart for adjusting the two hook bolts which are bent

from a $\frac{1}{4}$ -in. brass rod, threaded and fitted with wing nuts as in Fig. 3. Fig. 4 shows how these bolts hook over the boat inwales. Oak blocks are next bolted to the extreme ends of the thwart and are fitted with $\frac{3}{8}$ -in. bolts for attaching the leeboards as in Fig. 3. Pieces of inner tube slipped over the bolts serve as rubber washers to keep the leeboards vertical. Strips of rubber as well as rubber-headed tacks are also fitted to the underside of the thwart to protect the finish of the boat. Next, the leeboards which provide lateral balance to the boat when under sail, are cut from 12-in. pine stock, following the design given in Fig. 2. The after edge of the board is tapered as shown in the sectional detail. A $\frac{1}{16}$ by 3 by 3-in. brass plate with a $\frac{1}{4}$ -in. hole made in the center to receive a brass pin driven up into the end of the mast, is screwed to the top side of the thwart at the center. The mast is held upright by two shrouds and a forestay, the shrouds being brought through holes in the side of the boat just below the gunwale and belayed to cleats attached to the thwart. See Fig. 2.

Details of the rudder, tiller and false transom, and the method of clamping the assembly to the stern with a pair of C-clamps are shown in Figs. 5, 6 and 7. Standard pintles and gudgeons are used to hinge the rudder, after which the tiller is pivoted at the top by a single bolt fitted with a wingnut. A small lanteen sail, similar to a canoe or kayak sail, of 50 or 60 sq. ft. area, is recommended.

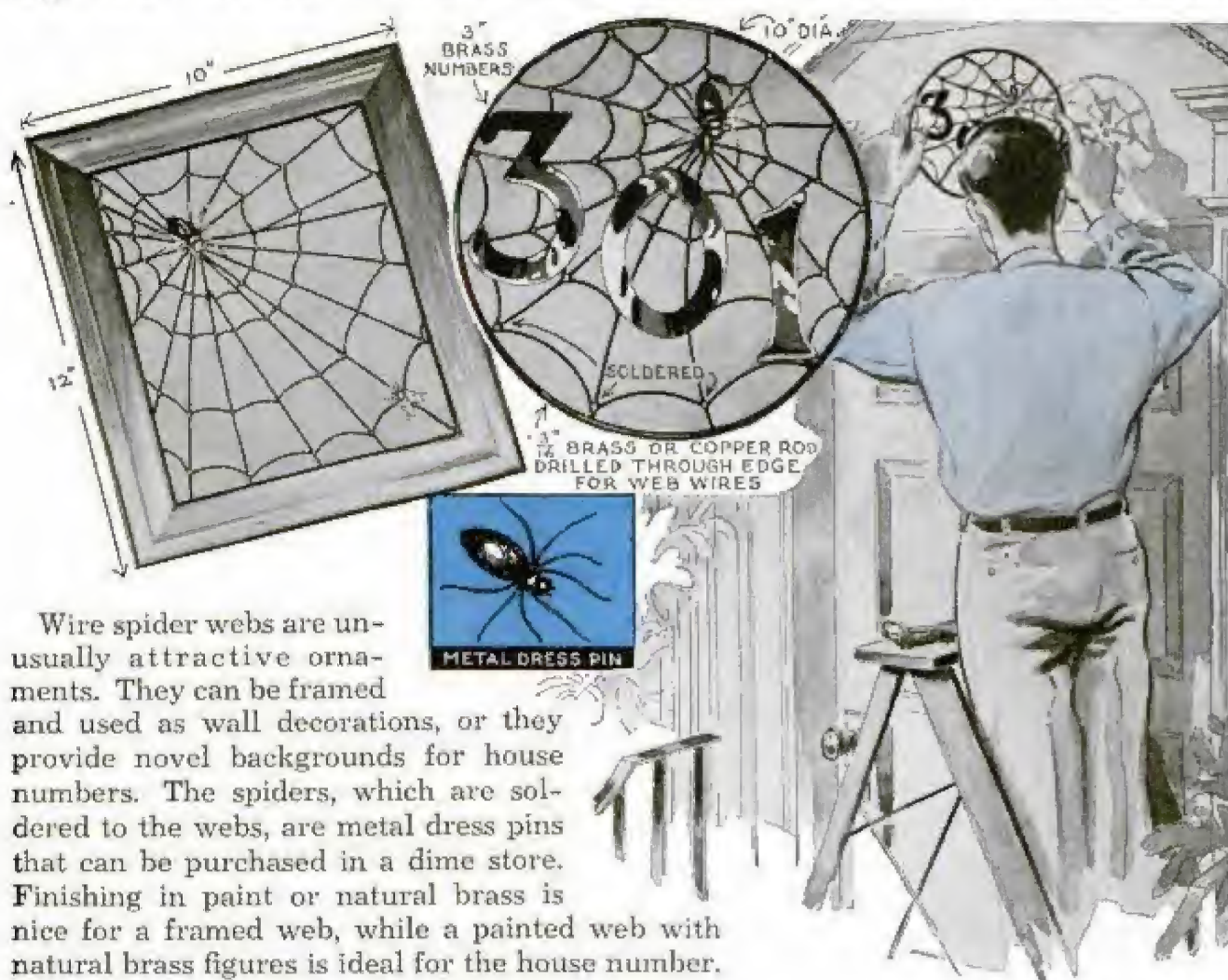
Jaws of Wire Nippers Are Altered to Strip Off Insulation



By drilling three holes through the jaws of a pair of wire nippers as shown, I found that they were handy for stripping insulation from wire. The holes should vary in size so that the nippers can be used for different sizes of wire. Each hole should be just a trifle larger than the wire it is intended to strip. It is a good idea to countersink the holes, thus reducing the thickness of the cutting edges so that they will cut through the insulation easily.

—Arthur Trauffer, Davenport, Ia.

Spider-Web House Numbers and Ornaments



Wire spider webs are unusually attractive ornaments. They can be framed and used as wall decorations, or they provide novel backgrounds for house numbers. The spiders, which are soldered to the webs, are metal dress pins that can be purchased in a dime store. Finishing in paint or natural brass is nice for a framed web, while a painted web with natural brass figures is ideal for the house number.

Folding Card Table and Umbrella for Picnics at the Beach



An old card table slotted through the top from one side to the center so that it will slip around the standard of a beach umbrella is handy for days spent at a beach where shade and picnic tables are unavailable. The table provides a good place to spread a lunch or play cards in the shade. Also, it will keep clothes and other articles out of the sand. As the table folds, both it and the umbrella can be carried easily.

Freezing Pen to Assemble It

Putting a fountain pen together can sometimes be an annoying problem, as the ink sack usually refuses to go back into place. I solved the problem by filling the sack with water and then freezing it solid in the ice-cube compartment of the refrigerator, after which it went together without difficulty. When the ice melted the pen was emptied in the usual manner.

—Philip La Point, Ottumwa, Ia.

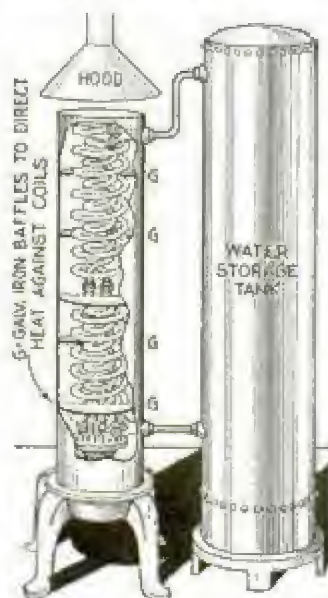
Gauge Aids in Cutting Your Hedge at a Uniform Height



I find that this simple gauge helps in trimming my lawn hedge at the same height. It is made of $\frac{3}{4}$ -in. wood and has an adjustable arm that projects over the hedge. Cheap furniture casters permit it to be moved along as the trimming progresses. Of course, the ground or sidewalk along the hedge must be fairly uniform, otherwise you are likely to trim the hedge to the same contour as the ground when using the gauge as a guide.

—George W. Peterson, Miami, Fla.

Improving Gas Hot-Water Heater



By simply attaching an extra coil to my gas hot-water heater, I was able to reduce gas consumption considerably in heating a given amount of water. The job was done as indicated, sheet-iron baffles being attached to the sides of the housing around the coils to deflect the heat against them. This

arrangement doubles the coil surface exposed to the heat, much of which is absorbed by the upper coil before passing out of the flue.

—A. J. Bruyere, Milwaukee, Wis.

Camp Stove Improvised from Pail

You need only a 5-lb. lard pail and an empty can to make a good outdoor stove. Punch a number of holes in the pail, then put a few pebbles in the small can to weight it down. Fill it with either gasoline or wood alcohol and set it inside the pail. Ignite the fuel and place your cooking utensils on top of the pail, which acts both as a holder for the utensils, and a windbreak for the fire.

—G. E. Valentine, Summerland, B. C., Can.



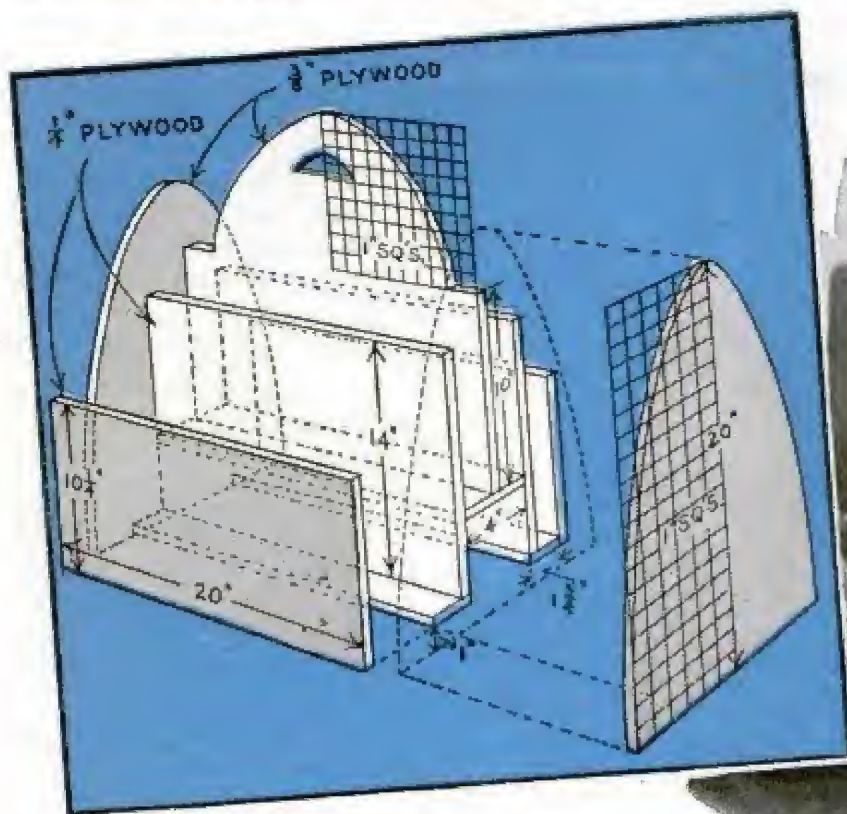
Cloth Apron around Tennis Table Prevents Ball Rolling under It

Table-tennis players who wish to avoid crawling under the table to retrieve a ball can do so by tacking a cloth apron to the table so that it extends to the floor. The cloth should be placed about 10 in. in from the table edge to prevent the players from stepping on it.

—Robert Scott, Saltsburg, Pa.



This Magazine Rack Is a One-Evening Job



Here is an attractive magazine rack that anyone can cut out with a scroll saw and assemble with a screwdriver. The ends and the center partition are $\frac{3}{8}$ -in. plywood, and the other partitions and sides are $\frac{1}{4}$ -in. plywood. Notice that the bot-

toms of the two center compartments are raised above the outer ones so small magazines can be seen. If desired, the edges of the plywood can be filled with a mixture of sawdust and glue, which is allowed to harden and is then sandpapered.

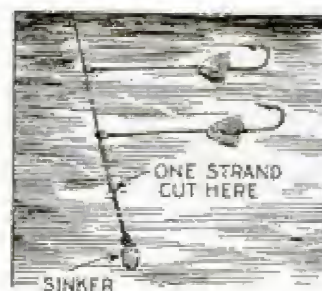
Belt Acts as Compass to Cut Circle in Sod Around Tree



When you want to cut sod around a tree or shrub, just use a belt, rope or heavy cord and a spade as a compass. Be sure to hold the spade vertically and snugly against the belt when making the cuts in the sod.

Avoiding Loss of Fishhooks When Line Snags

If you are fishing in water where the bottom is rocky, or there are other obstructions that may snag your tackle, try the method shown. Partly sever the line between the sinker and the hooks. Then if the sinker catches on something, a jerk will break the line so that only the sinker is lost.



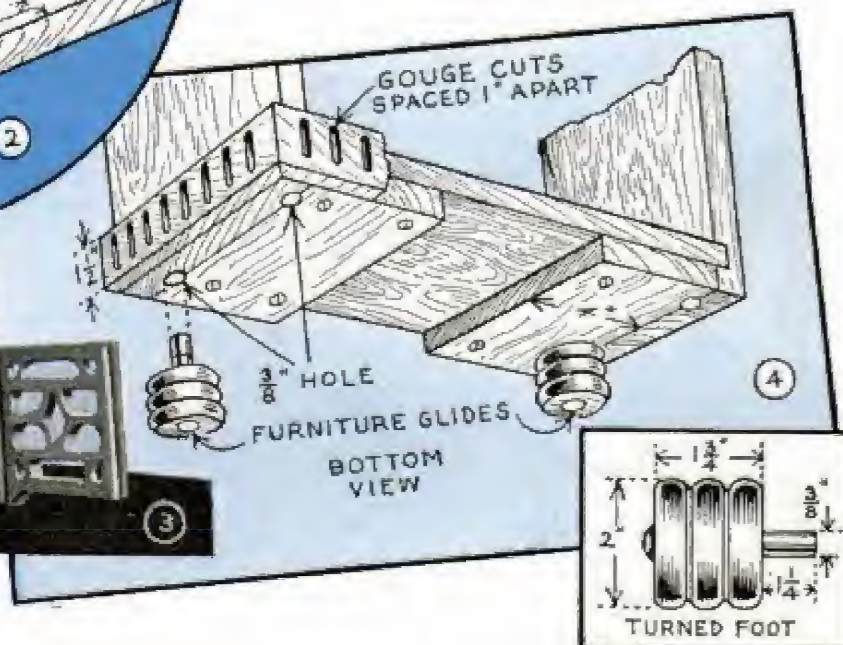
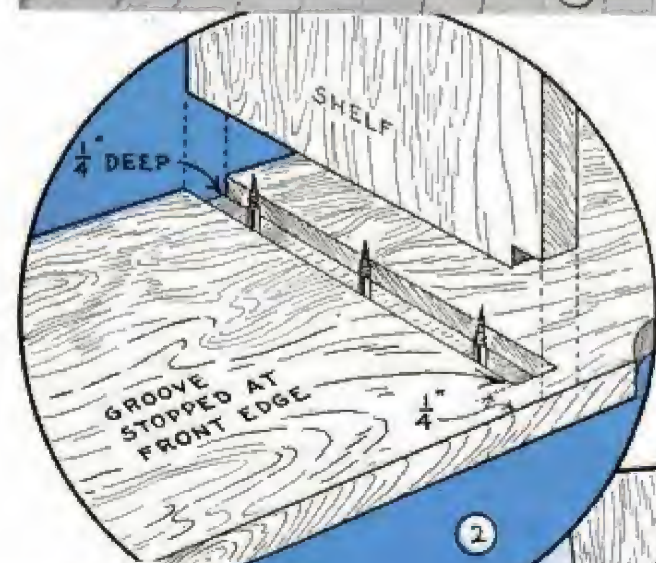
—Henry Gifford, New York, N. Y.

TWIN



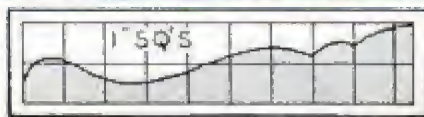
A PAIR of these graceful pier cabinets is just the thing to liven up dull places on each side of a wide doorway. Or, used individually, they are ideal for vacant corners where nothing else seems to fit in well. While the original was made of knotty pine, Fig. 1, sycamore, mahogany or walnut are attractive woods for the job. Side members are cut from $\frac{3}{4}$ by $9\frac{1}{2}$ -in. pieces, and have "stopped" grooves for the shelves, which are screwed in place as shown in Fig. 2. Stopping the grooves in this manner gives the front of the cabinet a neat appearance. Making the cabinet is an easy job with hand tools. If, however, the grooves are to be run on a dado head and finished with a chisel, Fig. 3, this work should be done before cutting the steps on the front edges of the side members. This leaves a straight surface to rest against the saw miter gauge while cutting the grooves, which must be started from the rear edges of the boards. The scroll work near the upper ends of the sides, Fig. 6, can be cut with a coping saw and smoothed with a wood rasp, Fig. 5. Cutting tenons on the upper ends of these members to fit mortises in the top piece finishes the sides. Fig. 7 gives all dimensions and shows the assembly.

Reinforcing blocks are screwed in place under the bottom as indicated in Fig. 4, and holes are drilled in them for feet, which are located at each corner of the



PIER CABINETS

balance wide doorway

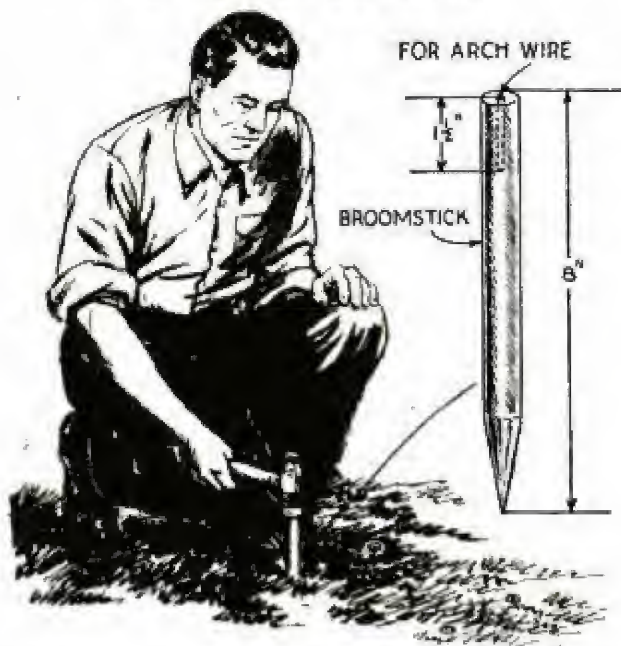


cabinet. The feet are turned on a lathe from the same material as the rest of the cabinet, dowels being formed on the ends to fit in the holes. If a lathe is unavailable, the feet can be short blocks shaped with a

plane. A wide molding around the bottom serves as a cover strip over the reinforcing blocks. This is decorated by making cuts vertically in it with a gouge. It is fastened in place with casein glue and finishing nails, which are countersunk with a nail set and puttied. A scrolled rail, cut as in the squared drawing under Fig. 5, is screwed across the top at the rear as a decoration.

In finishing, an oil stain is recommended for soft woods such as pine. Water stain is satisfactory for walnut, mahogany, etc., with an application of wood grain filler. Two coats of shellac are then applied, allowing it to dry thoroughly between coats, and smoothing after each coat with fine steel wool. An application of floor wax rubbed well completes the job.

Croquet Arches Located Easily by Stakes in Lawn

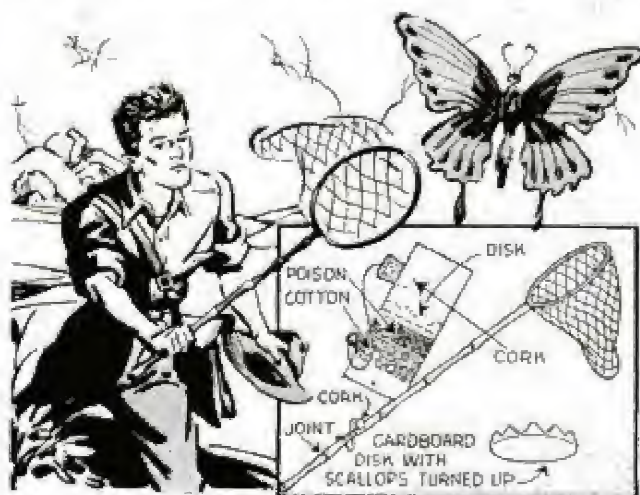


To avoid the trouble of relocating the proper positions for croquet arches, which had to be removed each time we quit playing, I drove stakes into the ground in the proper locations to take the arches. The stakes were made from lengths of broomstick and were drilled in the upper ends to receive the ends of the arches. Being flush with the top of the ground, the stakes did not interfere with use of the lawnmower, and there was no possibility of anyone tripping over them.

—Frederic Chenot, Louisville, Ohio.

Butterfly Net Has Gas Chamber to Kill Insects

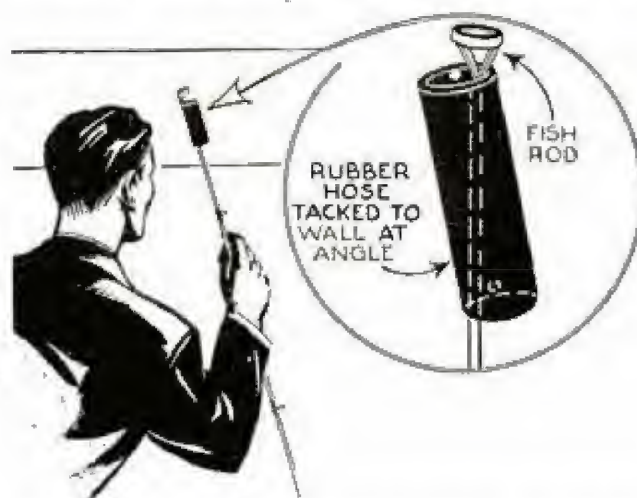
Instead of carrying a bottle of carbonated ammonia or other liquid for killing insects that have been caught in a net, why not provide a poisonous gas chamber right in the handle? If the handle is bamboo,



this is done easily. Drill a hole between two of the joints and fill the hollow portion almost to the hole with the poison. On top of this, place some cotton and hold it in position with a cardboard disk, which has been serrated around the edge as indicated. A cork in the hole prevents the escape of fumes. In use, just remove the cork and insert the insect to be killed.

Rubber Hanger for Fishing Rod

A good hanger for a fishing rod can be made by simply tacking a short length of rubber hose to a wall at an angle. The rod is inserted into the hose, and its tendency to hang vertically causes the tip to bind at



the top and keep it from slipping out of the hose. Such a hanger has the advantage of not injuring the agate tip no matter how carelessly the rod is inserted into it.

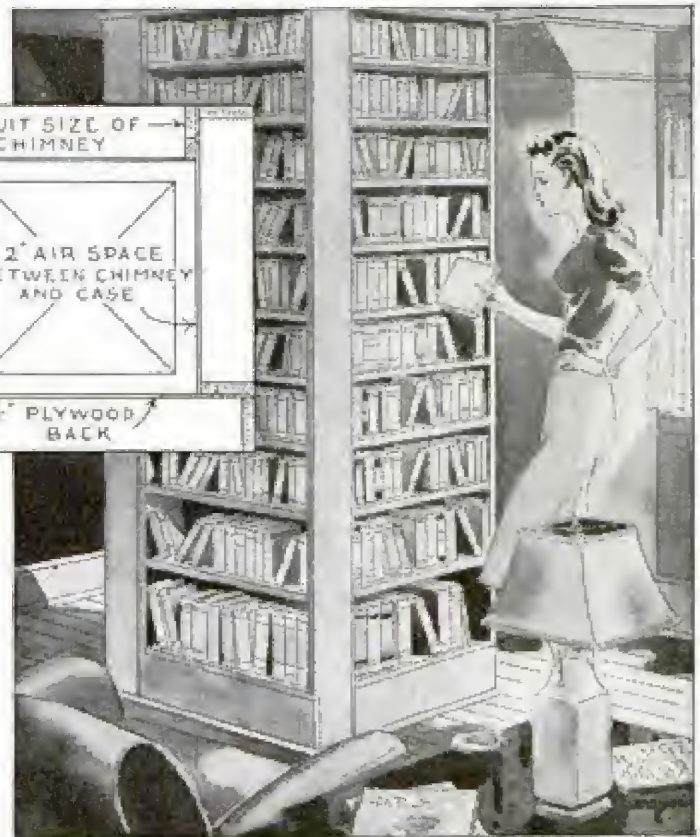
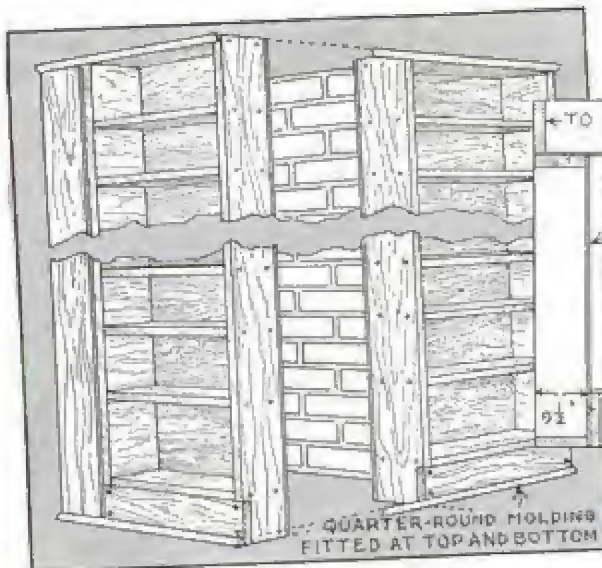
Flowerpot Rack Hooks to Window

Finished to match the window trim, this neat rack will hold potted plants in a window without detracting too much from its appearance. The sides or brackets are made of hardwood and are joined at the bottom by lengths of dowel stock, which serve as a shelf. Thin, metal clips at the upper ends of the sides slip between the two window sash.



It is easy to break up nut meats if you will place them in a paper bag and go over them several times with a rolling pin.

Open Bookcase Hides Chimney in Attic Room



If an unsightly chimney mars the appearance of an attic room, build a bookcase around it and "kill two birds with one stone" by hiding it and providing additional book storage space. Allow at least a 2-in. air space between the case and the chimney. The case is made in four sections, and if this gives more space than is needed for books, fit doors to some of the sections and use them as cabinets. Or, you can build an upholstered

seat around the lower part and put shelves in the upper part for books.

—Chester W. Colburn, North Weare, N. H.

Building Jack under House Beam Used as Veneer Press



In an emergency, a screw-type car or building jack can be used as a veneer press if the total area of the work surface is small enough for pressure to be applied uniformly to it by a piece of $\frac{3}{4}$ -in. plywood, which is used as a pressure plate. Assemble the work and plate on a smooth place of your basement floor directly under a floor beam. Generous use of newspapers under the work will help compensate for any unevenness in either the work or the floor. Then set the jack on three short pieces of 2 by 4-in. stock assembled as shown, and use a long piece between the jack and the beam.

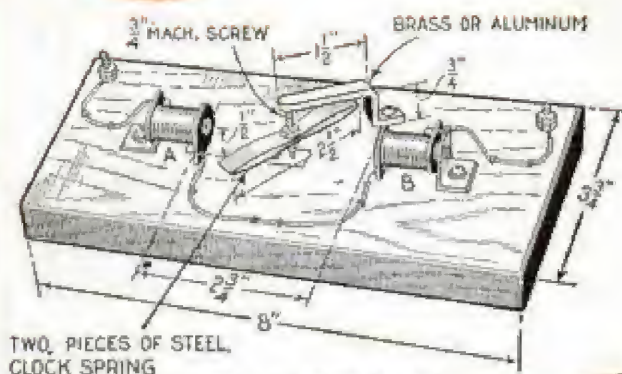
—Edw. J. Hobert, Hempstead, N. Y.

Care of Lilac Bushes

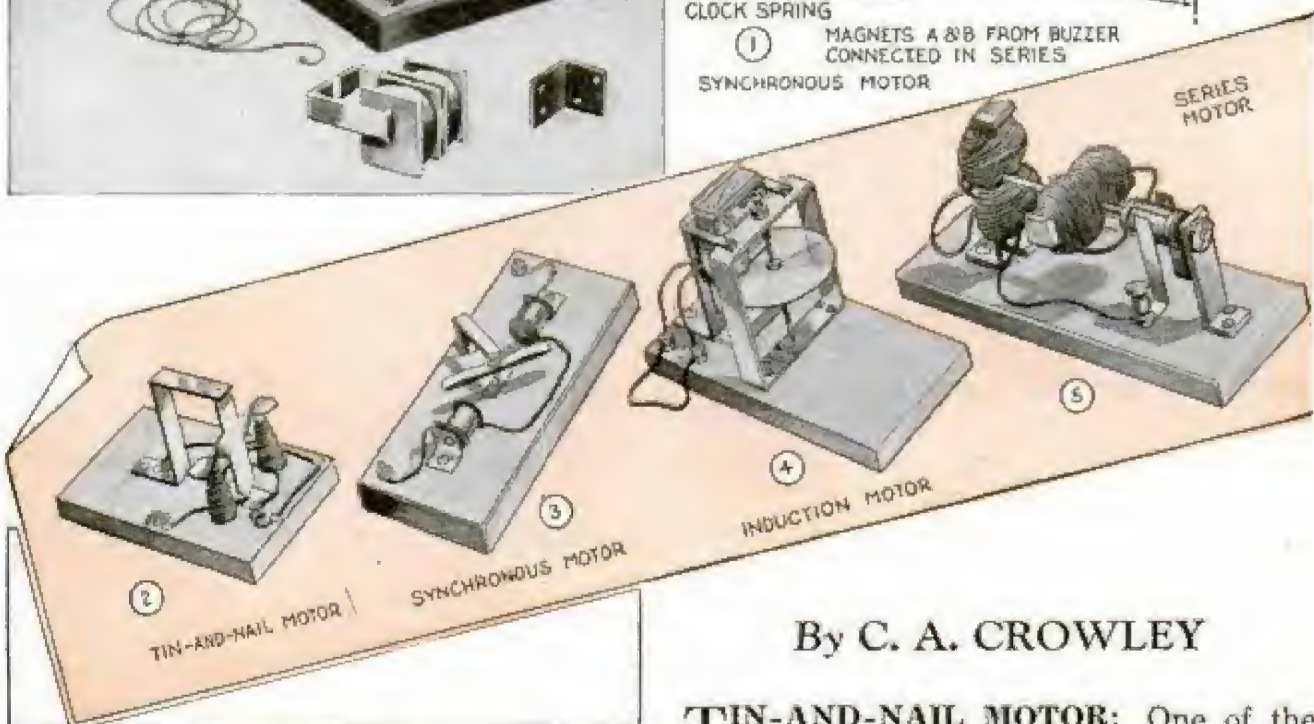
Lilac bushes require plenty of room, good drainage and cultivation. Every spring add a top dressing of well-rotted manure, and a little bone meal occasionally. Lilacs require little pruning aside from the usual gathering of bouquets.



5 TOY

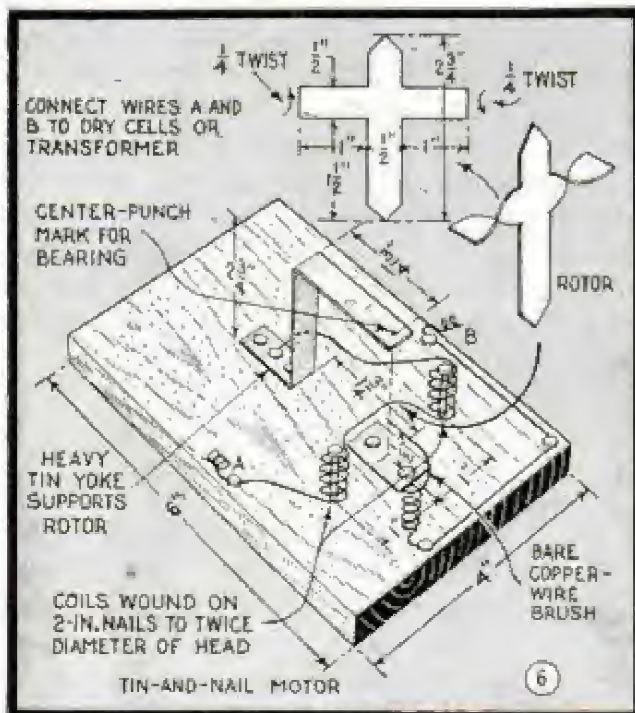


① TWO PIECES OF STEEL, CLOCK SPRING
MAGNETS A & B FROM BUZZER CONNECTED IN SERIES
SYNCHRONOUS MOTOR



By C. A. CROWLEY

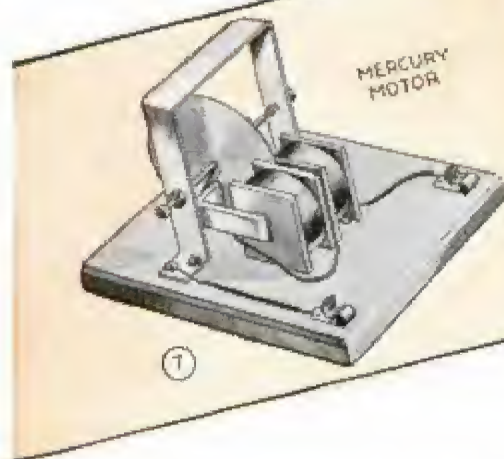
TIN-AND-NAIL MOTOR: One of the simplest forms of an electric motor where small electromagnets cause a tin rotor to spin, is shown in Figs. 2 and 6. This motor runs on a couple of dry cells or will operate on 6 volts a.c. provided by a transformer. The rotor acts like a tiny switch as it wipes against a brush lightly, turning on current momentarily just before its arms pass over the electromagnets. This current impulse, which occurs at each half rotation, is just enough to keep the rotor going. The rotor is cut from tin to the cross shape shown and the side arms are twisted at right angles. The electromagnets or field coils are wound in series on two nails, both windings being in the same direction. The nails are 2 in. apart. One end of the wire is scraped bare and twisted to form a tight coil which serves as a binding post, it being tacked down to



MOTORS

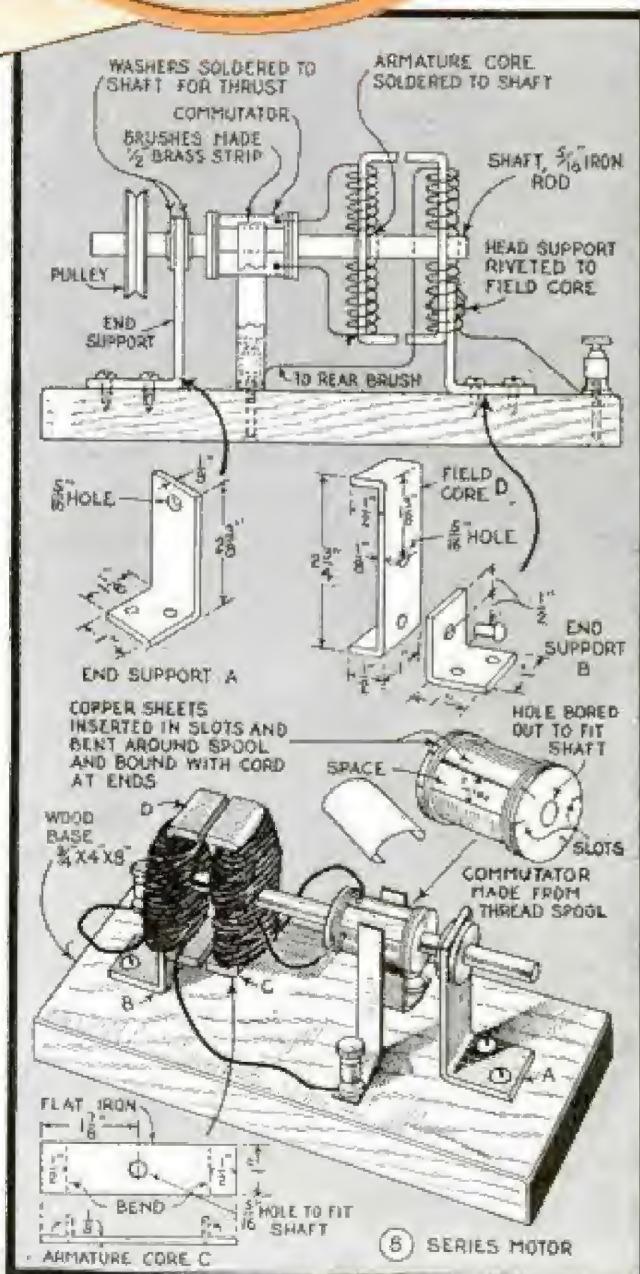
convey basic ideas

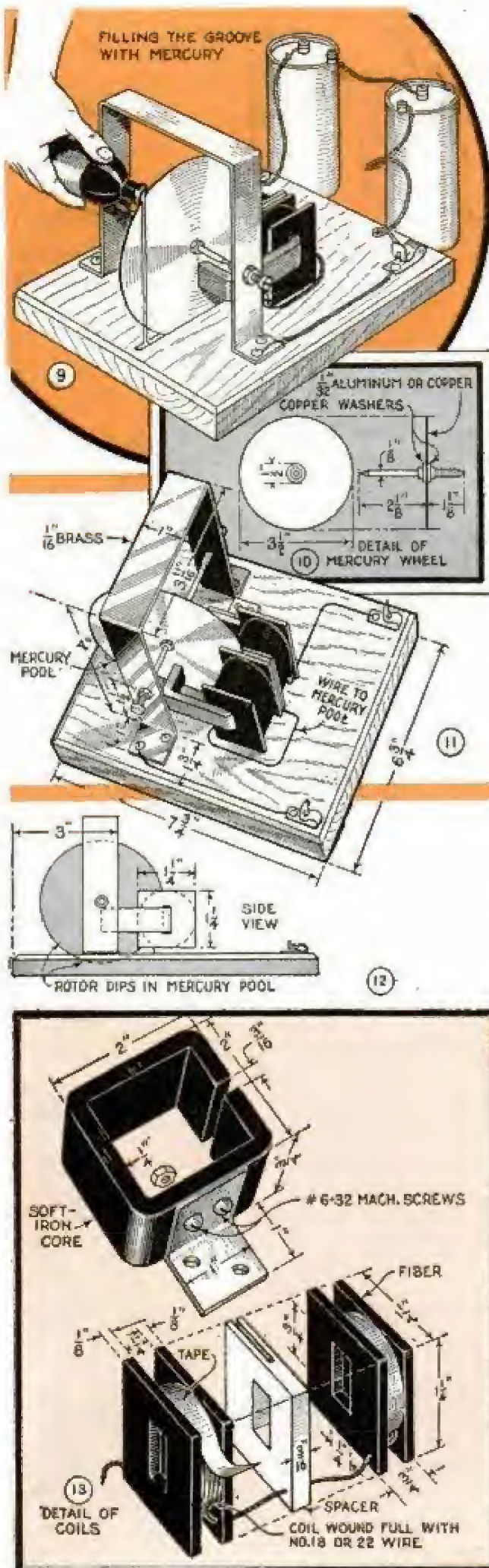
These simple electric motors, which run on low-voltage a.c. or d.c. as specified, are constructed from nails, wire and scraps of iron and tin. All of them have been built and made to operate; one provides ample power to drive small toys



the baseboard at point A, Fig. 6. At this point connections to a transformer or battery are made. The other end of the wire is tacked to the yoke that supports the upper end of the rotor. A length of bare copper wire is used as a brush, rubbing lightly against the edges of the rotor about $\frac{1}{2}$ in. above the base. It is formed to a coil to provide flexibility. The other end of the brush wire is bared and formed into a binding-post coil at point B to which the other side of the transformer or battery is connected. Center-punch marks are made in the yoke and in a small tin base plate, halfway between the two nails. Then the rotor is set in place so that the arms are about $\frac{1}{8}$ in. above the tops of the nails. The brush is adjusted so that it touches the edges of the rotor and also releases before the arms pass over the nail heads. After connecting the motor to the current supply, give the rotor a start by turning it and the motor should run.

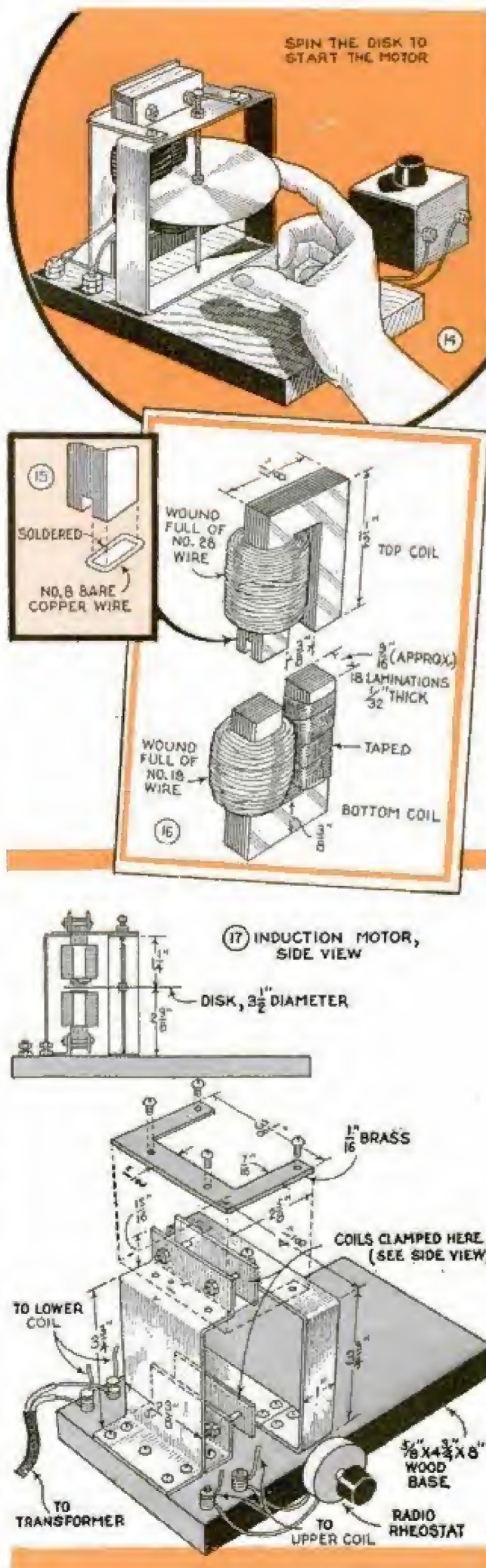
Synchronous Motor: A synchronous motor is one that operates at a constant speed, which is equal to or a submultiple of the frequency of the alternating current supplied to it. A simple synchronous motor



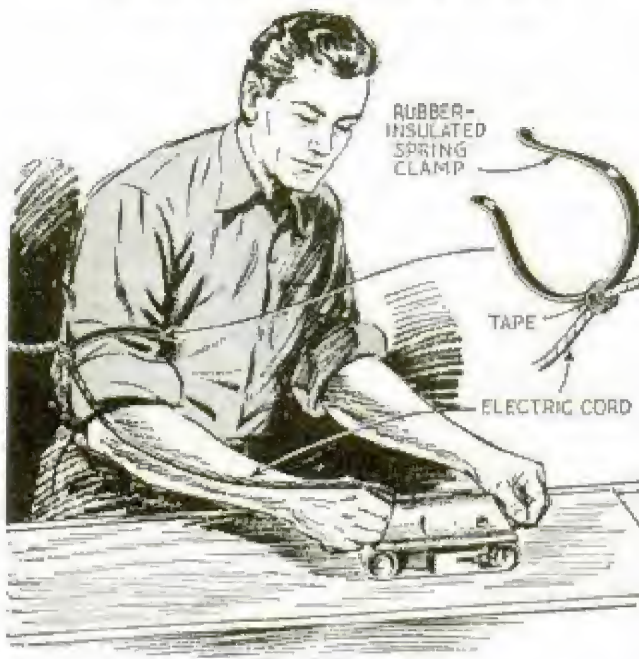


small shaft which is placed between two machine screws which are center-punched at one end to serve as bearings and are locked to the frame with nuts. The mercury pool is cut in the wooden base, directly under the rotor. Next, an electromagnet is made. The core is $\frac{1}{4}$ -in. flat iron bent as shown in Fig. 13 and the two coils are wound full of No. 18 or No. 22 magnet wire, a spacer being placed between them. Both coils must be wound in the same direction. The electromagnet is mounted so that the rotor revolves freely between the coils, and the poles of the magnet are directly below the shaft of the rotor. Electrical connections are shown in Fig. 11. One terminal is connected to the coil, and the other side of the coil is connected to a wire dipping into the mercury pool. The rotor also dips into the pool. The second terminal is connected to the frame of the motor.

Induction Motor: Operated on low-voltage a.c. from a toy transformer, the disk-type induction motor shown in Fig. 4 exemplifies a principle used in meters of various types. It will not operate on d.c. Details of parts are given in Figs. 14 to 17 inclusive. The laminations used are approximately of the dimensions shown in Fig. 17 and can be obtained from an old audio transformer used in radio. Two stacks of laminations, each $\frac{9}{16}$ in. thick, are required for the lower and upper coil. The upper coil is wound with No. 28 d.c.c. wire, enough wire being wound on the coil to fill the winding space on the core. The lower coil is wound with No. 18 wire. The leads from each coil are brought out to a pair of binding posts on opposite sides of the motor. The core of the upper coil is drilled directly below the coil and a single turn of No. 8 bare copper wire is inserted as shown in Fig. 15. The ends of this wire should be lapped carefully and soldered together. The frame is made of No. 16-ga. sheet brass. The rotor is a disk of sheet copper or aluminum. It is moved up or down on the shaft until it is in the proper position between the two cores. The upper coil terminals are connected to a radio rheostat and the lower coil is connected to the transformer supplying 6 volts. It will be necessary to shift the upper coil slightly to one side or the other in order to get the motor to operate properly. Once the proper position has been found, the speed can be controlled by adjusting the rheostat.



Spring Clamp Holds Sander Cord Out of Operator's Way



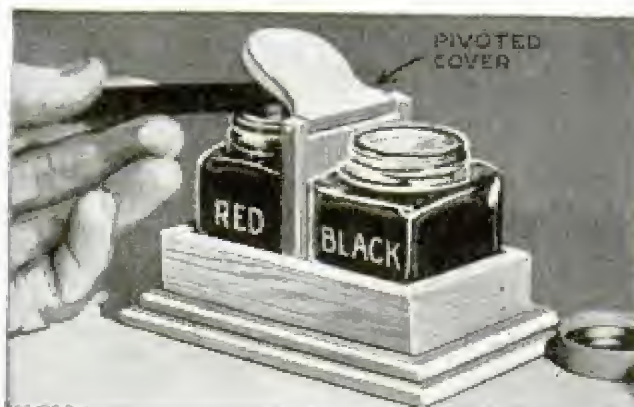
To keep the electric cord out of the way when operating his portable electric sander, a carpenter uses a spring clamp, which holds the cord to his arm. The clamp is insulated with a covering of rubber tubing.

Fine Wire Replaces Silk Winding on Fishing Rods

The next time you have to replace the winding on your fishing rod, try fine copper wire instead of silk thread. The wire will last longer and produces a neat appearance when carefully wrapped. A drop of solder melted over the windings and smoothed out with a hot iron prevents the ends from coming loose.

Dipping of Pen in Wrong Ink Avoided by This Stand

Holding bottles of red and black ink, this stand has a pivoted cover that is



turned over the bottle not being used so that there is no possibility of accidentally inserting the pen in the wrong one. Both inks cannot be exposed at the same time, and the cover is so loosely pivoted that it will not remain in a vertical position.

Tension Spring in Guy Rope Helps Prevent Breakage

Springs of the desired strength inserted in guy ropes and lines of tents and other objects will provide some give in the ropes and help prevent breakage of the lines in

sudden gusts of wind. The detail shows how the springs are installed close to the anchoring stakes.



Tree "House" for Little Tots

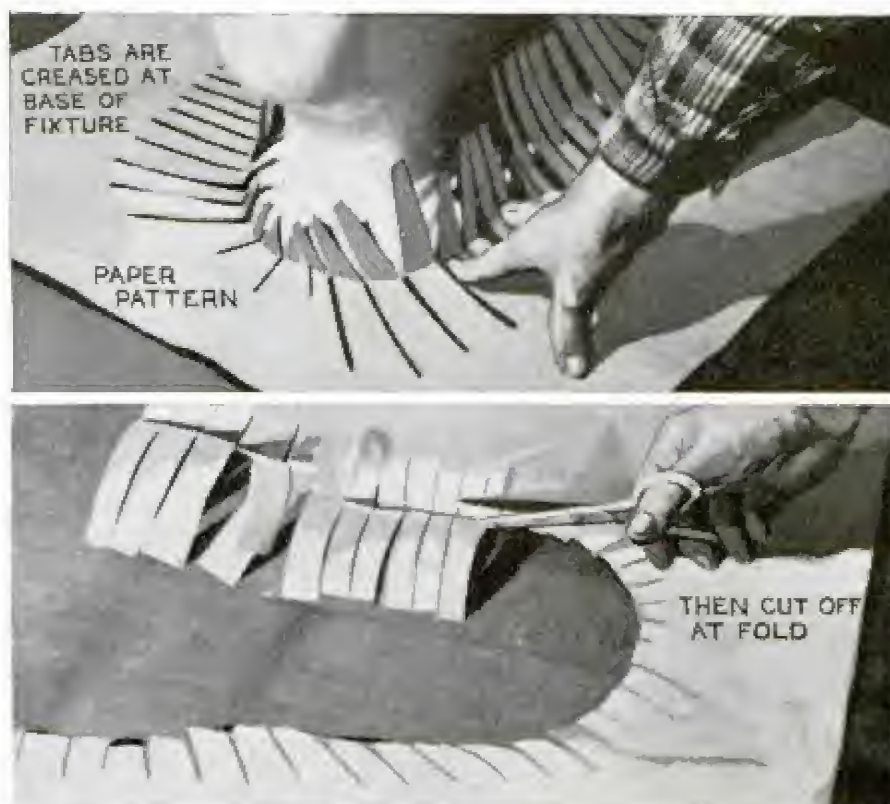


Built around the trunk of a tree, this house is nothing more than a platform with a strong railing along all four sides. It is 3 or 4 ft. above the ground, and the impression of height is increased by a small ladder from the ground to an opening in the railing.

⌚Tennis players whose racket handles get smooth and slippery and turn in their hand while playing, should keep a small piece of rosin at hand and rub it on the racket handle as often as is needed.

Pattern Fits Linoleum Around Fixed Objects

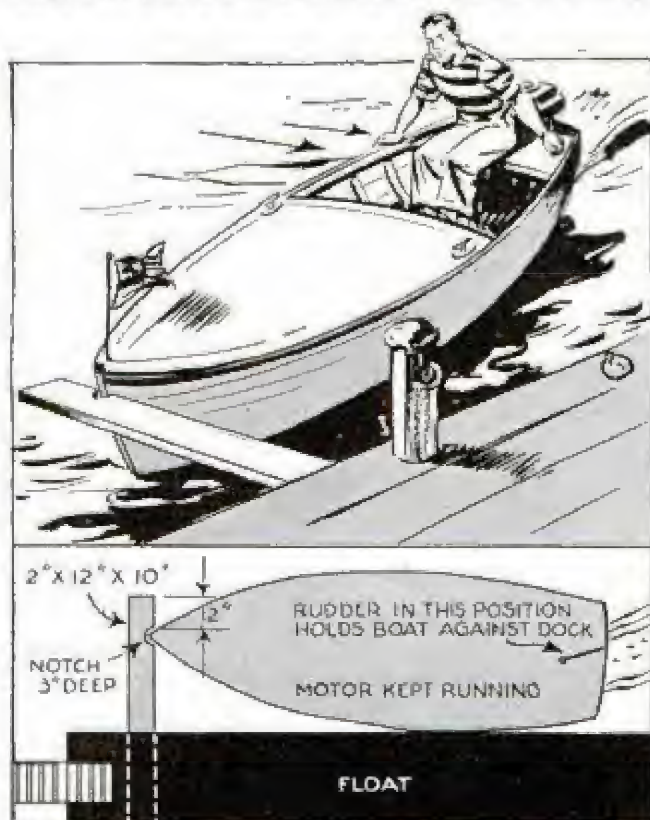
Difficulty often experienced in laying linoleum around fixed objects on the floor can be overcome by making up a pattern as follows: Take a piece of heavy wrapping paper and make a slit part way through the center. Then make cuts radiating in all directions from the slit toward the edges of the paper. Slip this around the object and press down the paper tabs around the object as shown in the upper photo, creasing each tab where it contacts the object. Then remove the paper and cut off the tabs at the folds. This will give you the outline of the object. Now measure the exact distance from two walls to the object. Then transfer this distance to the linoleum, measuring from the two edges of the linoleum that will be laid



along the walls from which the measurements were taken. Use the pattern to cut the opening in the linoleum at this point and it will fit accurately around the object.

An Easy Method of Docking Boat Against Adverse Currents

To simplify docking my boat when alone and the tides are adverse, I nailed a heavy



plank to the dock as indicated, and cut a large notch near the outer end to take the bow of the boat. In docking, I ease the stem into the notch and leave the propeller going with the rudder turned to move the boat against the dock while I make the lines fast. Also, the plank is handy for backing out the boat when the current tends to hold it against the dock, because I can swing the stern to the desired angle and then back straight out into the clear.

—Arne O. Salonen, South Bend, Wash.

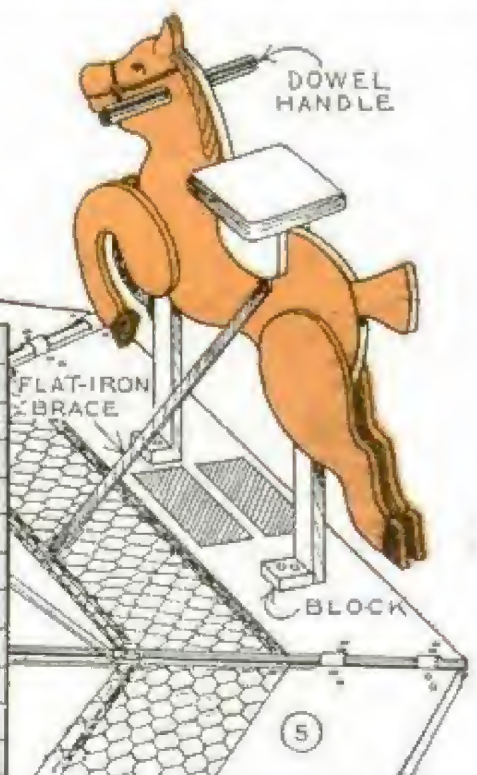
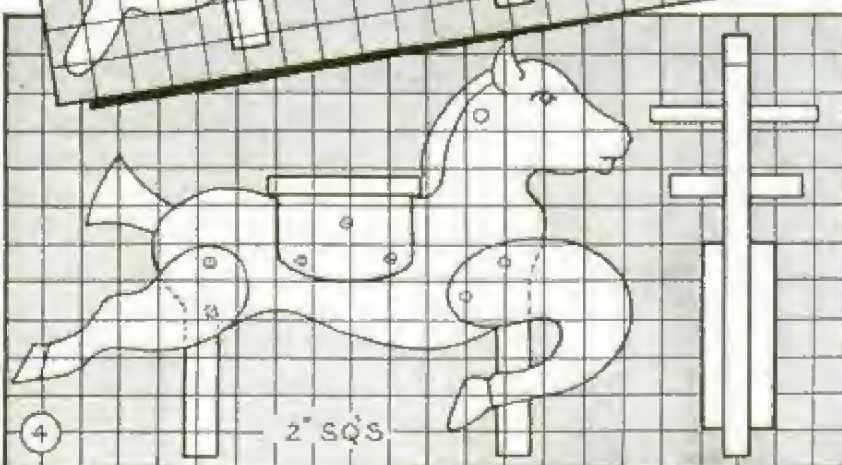
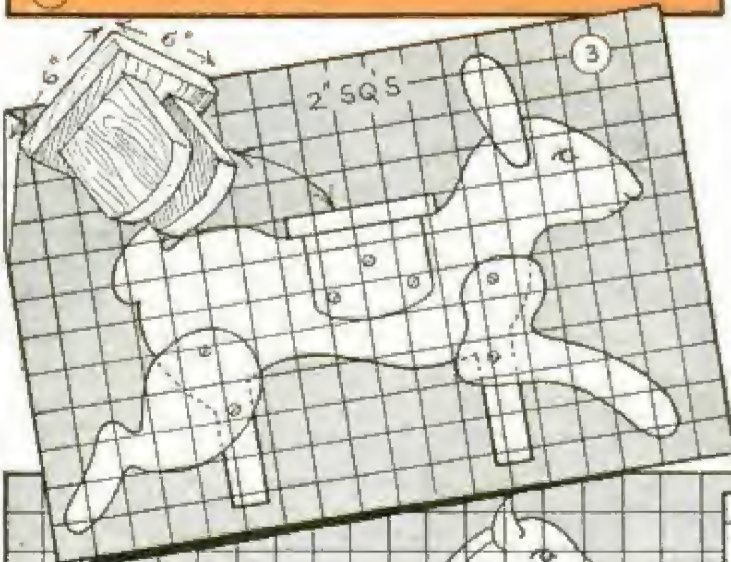
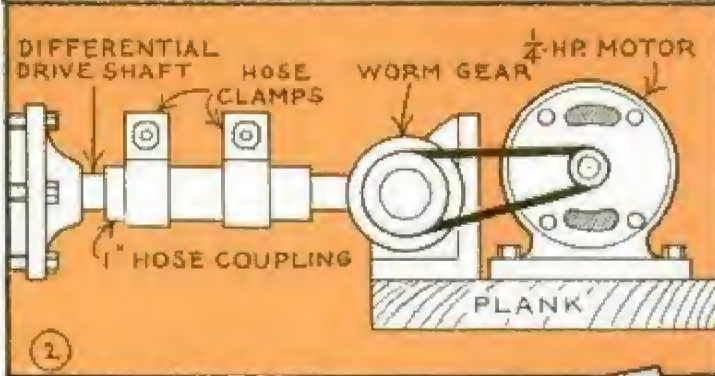
Keeping Dogs Out of Flower Bed

If your dog has a habit of lying in the flower bed, drive a few stakes in the ground at his favorite spots. The stakes, which should project above the ground about 2 in., will be hidden by the flowers.

Use bottles with screw-on medicine droppers in the kitchen. Fill with flavoring extracts, fruit coloring or any liquid you might wish dropped in small quantities.

Motor-driven

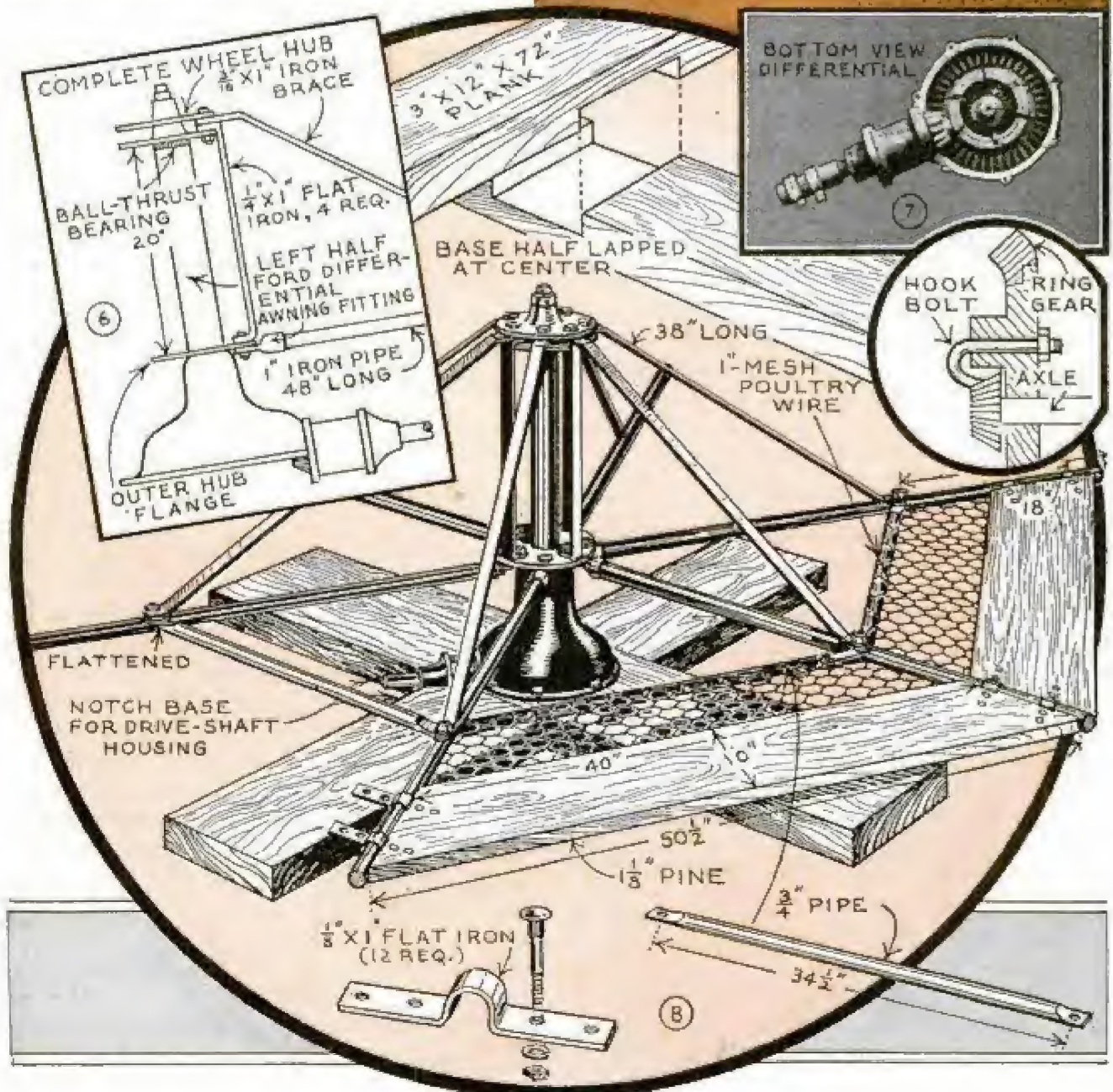
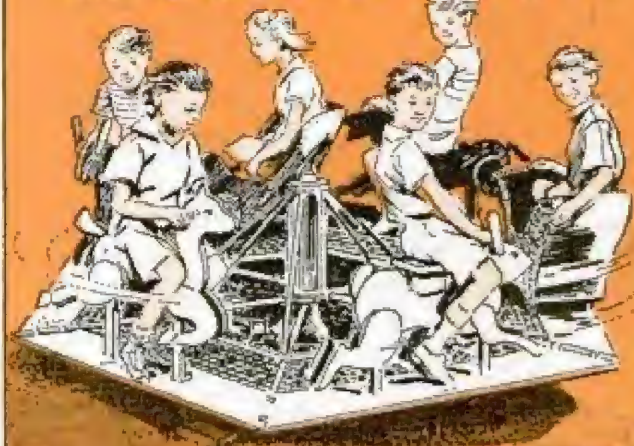
YOUR small children will have good reason to stay in their backyard to play if they have this merry-go-round. Outside of a $\frac{1}{4}$ -hp. electric motor and a reduction gear, it is assembled chiefly from pipe and old car parts. To begin, make a cross of heavy planks for the base as in Fig. 1 and on this, mount the left half of a car axle housing and differential, including the ring gear, axle and drive pinion complete as in Fig. 7. Use J-bolts to lock the spider gears of the differential as shown in the circular detail of Fig. 8, so that the axle will rotate when the ring gear is turned. Next mount the motor and reduction gear on a base and connect it to the differential drive shaft by means of a piece of hose and clamps as in Fig. 2. Now you are ready for the platform and its supporting members. First ream an outer wheel-hub flange to a turning fit over the axle housing and then put a complete wheel hub on the end of the axle as in Fig. 6. Assemble these two parts into a unit by means of vertical pieces of flat iron. The platform is carried on six horizontal lengths of



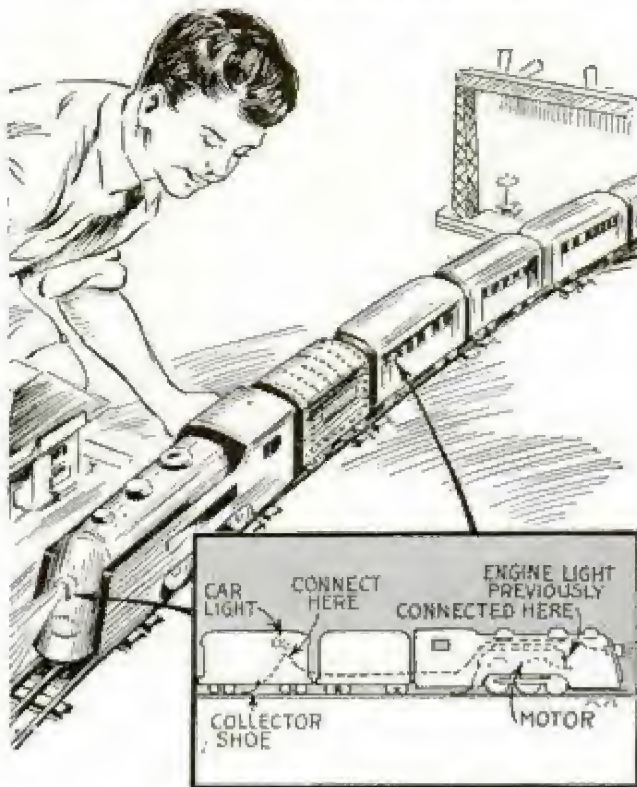
MERRY-GO-ROUND

1-in. pipe, which are attached to the reamed flange with awning fittings, and spaced equally by means of horizontal braces of $\frac{3}{4}$ -in. pipe. Flat-iron braces running from the wheel hub on the axle to the horizontal members complete the supporting assembly. Iron brackets bent to fit over the horizontal pipes are used to join the platform boards. Animals can be mounted on the merry-go-round if desired. A horse and rabbit are shown in Figs. 3 and 4. Fig. 3 also shows how a seat or saddle is made and attached, while Fig. 5 gives the method of mounting and anchoring the animals.

Seats Six



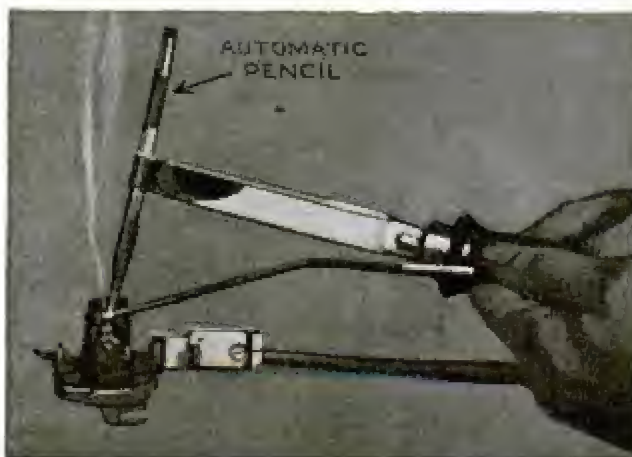
Train Lights Wired to Stay On over Dead-Track Section



Much of the realistic effect of a lighted toy train is lost if the lights go out when the engine passes over or stops on a section of the track that has been made "dead" temporarily by the automatic controls. To avoid this, add an extra collector shoe to the rear car of the train and connect it to the light circuit. In this way the train will always be lighted as long as either the engine or rear coach is on a "live" portion of the track.—Wm. Naken, Chicago.

Pencil Provides Small Electrode for Arc-Soldering Outfits

Owners of small carbon-soldering outfits can increase their utility by using a cheap mechanical pencil as an auxiliary electrode

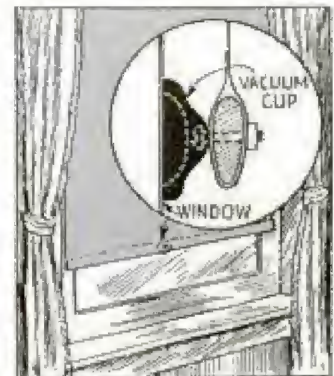


for fine and delicate work. If the pencil barrel is enameled, scrape off enough for the electrode clamp to make good electrical contact. The pencil is used just as the regular carbon, the lead being run out for a distance of $\frac{1}{2}$ in. or more. The thin lead offers considerable resistance to the passage of current and will instantly become white hot up to where it enters the pencil. The small point permits use of the outfit in places where the larger carbon cannot be inserted, and the metal barrel of the pencil offers protection against breakage of the lead.

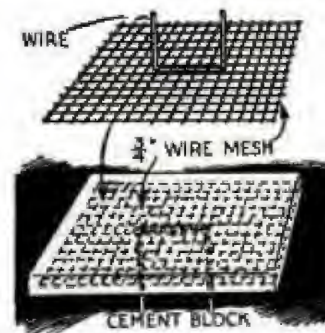
—W. C. Wilhite, Carlinville, Ill.

Vacuum Cup Holds Shade to Avoid Flapping

A vacuum cup attached to the center of a window-shade slat can be stuck to the windowpane to keep the shade from flapping in the wind when the upper sash is lowered at night.



Reinforce Your Stepping Stones When You Cast Them

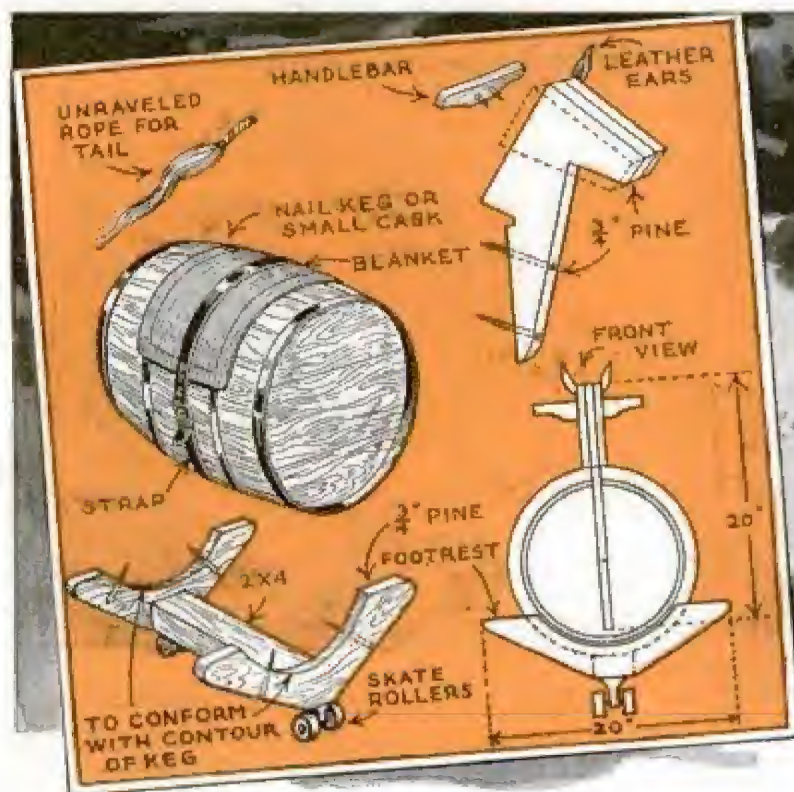


If you are going to make stepping stones out of concrete, reinforce them with heavy wire mesh and they can be made lighter and at a saving in materials. When you lay in the mesh, bend a length of heavy wire to a U-shape and insert it so that it will project 3 or 4 in. from the underside of the stone after the latter has been poured. Then when the stones are placed on the lawn, the projecting wires will be pushed into the ground to help keep the stones from being moved about easily.

—Dale R. Van Horn, Lincoln, Nebr.

☞ An old whisk broom is ideal for watering tiny seedlings; dip the broom in tepid water and shake over the plants.

"Barrel Bronco" Gives a Fast Sidewalk Ride



Why not dress up a simple roller-skate scooter to resemble a bronco which you can mount? A small, strong keg is attached securely to a cradle and a scroll-sawed head is screwed to the front end of the keg. A cleat on the head serves as a han-

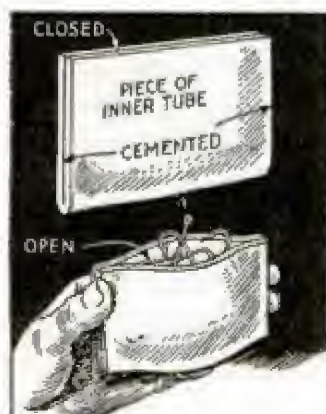
dlebar. Mane and tail are simulated by unraveling lengths of rope, which are attached, while the ears are cut from leather, and a piece of rug or a doubled blanket is strapped to the keg to form a saddle.

Marbles for Chinese Checkers Kept in This Wood Case

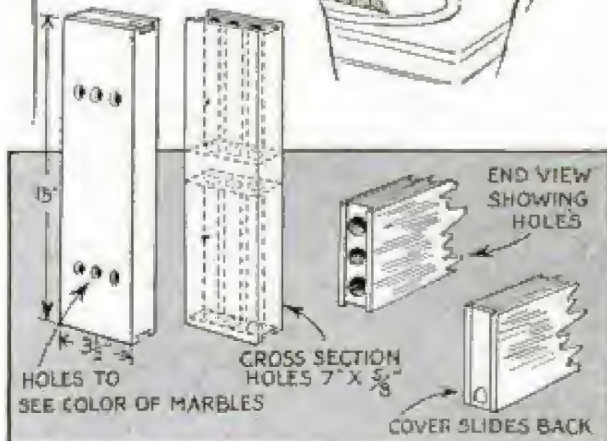
Instead of keeping marbles for your Chinese checker game in a bag you will find this simple container much handier and the marbles can be separated as to color. It is made from a wood block, holes being bored lengthwise to receive the marbles. Sliding covers at the ends have beveled edges, which fit in grooves. Peepholes enable you to select the desired marbles.

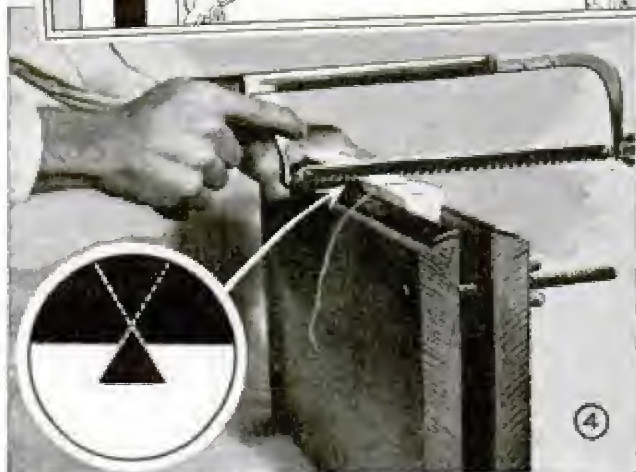
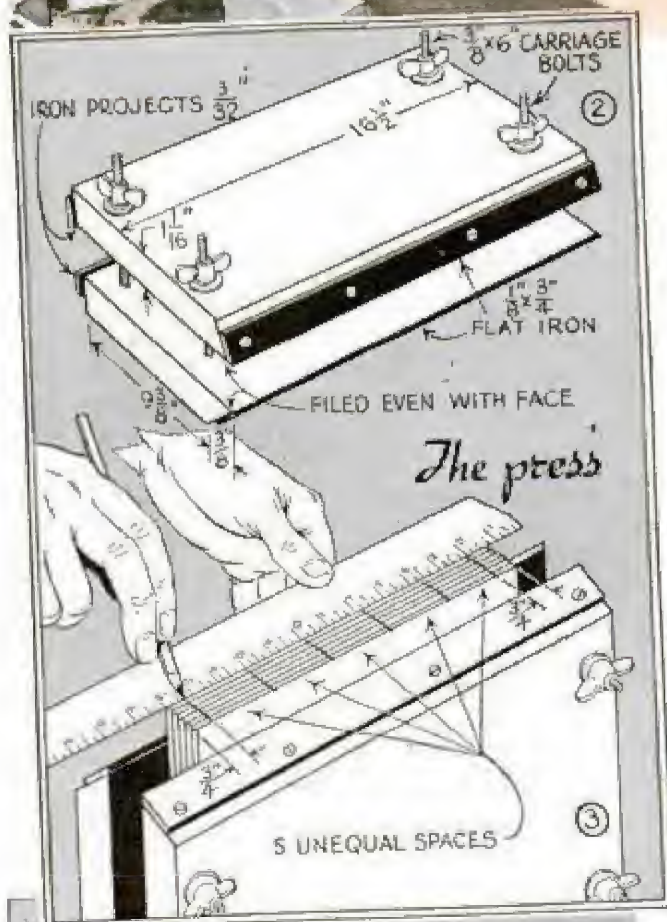


Self-Closing Pocket for Fishhooks



By folding a piece of inner-tube rubber and cementing the ends together, you have a practical case for fishhooks. The case will remain closed until the ends are pressed toward each other.

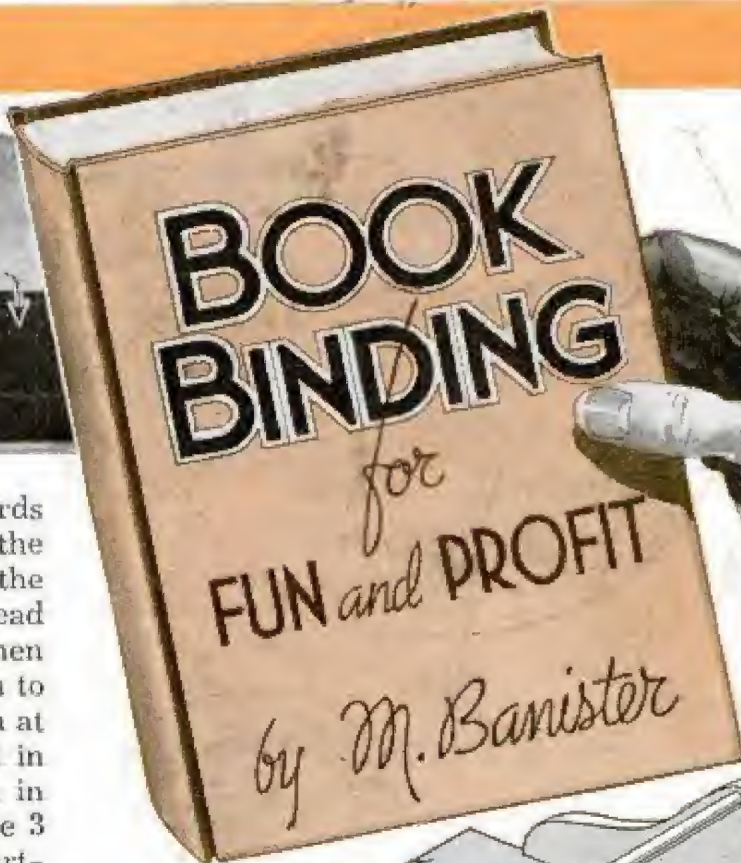




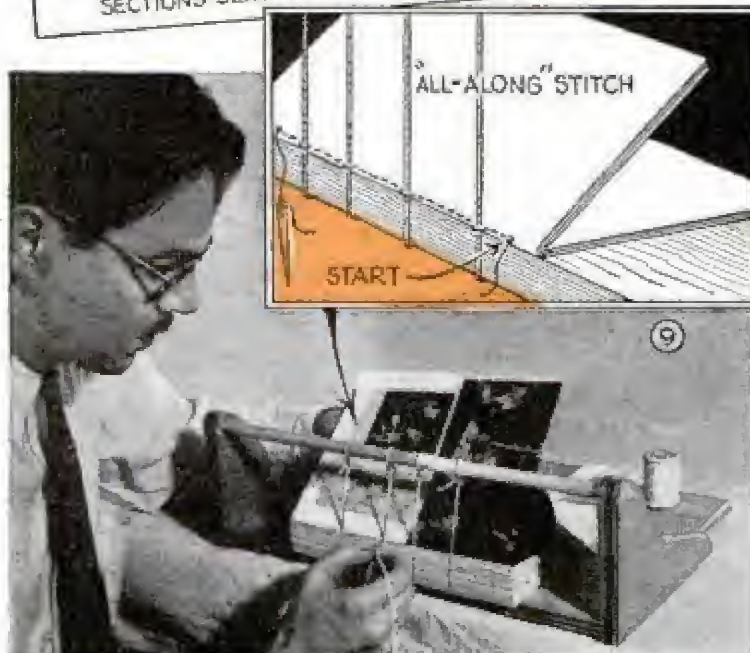
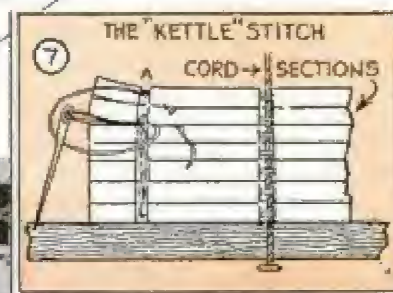
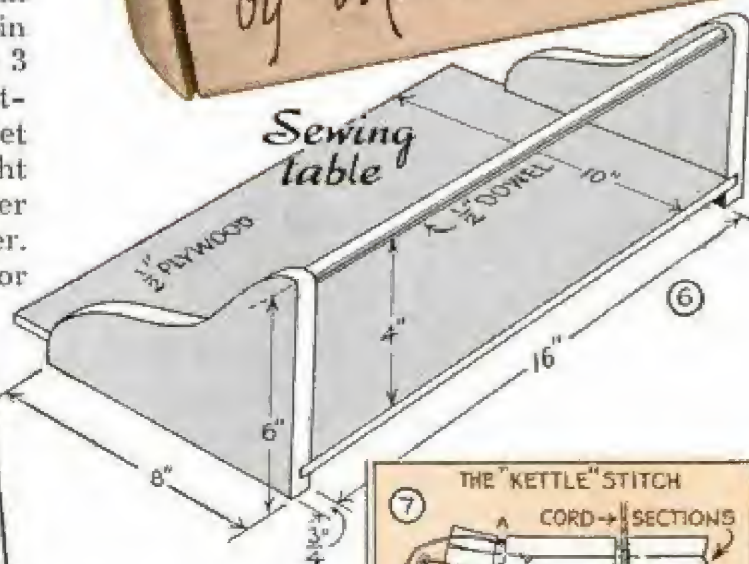
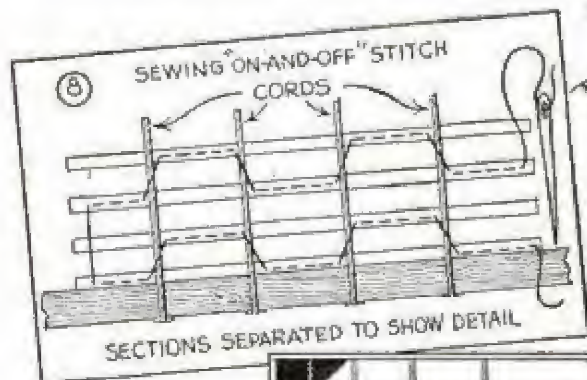
TORN, worn and faded volumes that detract greatly from the neat appearance of your library can be given new covers of leather or cloth and even improved beyond their original appearance when new. Such rebinding can be done at home by anyone. Also, when an accumulating stack of old magazines becomes a problem, why not separate the portions of them you wish to save and bind these together in yearly volumes?

Only a few simple pieces of equipment are required, namely: a press, sewing table and trimming board which are detailed in Figs. 2, 6 and 15. To bind magazines, begin by tearing off the covers and pulling out the staples as in Fig. 1. Separate the sections, being careful not to tear the backs, especially if glued. Align the edges by "jogging" the sections on the table until the back is flat and then clamp the stack in the press. Next mark lines across the back $\frac{3}{4}$ in. from the head and tail, as in Fig. 3, and divide the remaining distance into five spaces. With a fine-toothed saw make two end cuts to a depth of $\frac{1}{16}$ in. to provide openings for inserting the needle when sewing. The other marks are undercut as shown in the circular detail of Fig. 4, to imbed heavy cords. If tapes, available at dry-goods stores, are used instead of cords, all cuts are made $\frac{1}{16}$ in. deep, a cut being made on each side of each tape.

Now for sewing: Place the first section face downward on the bed of the sewing table. Using the saw marks as guides,

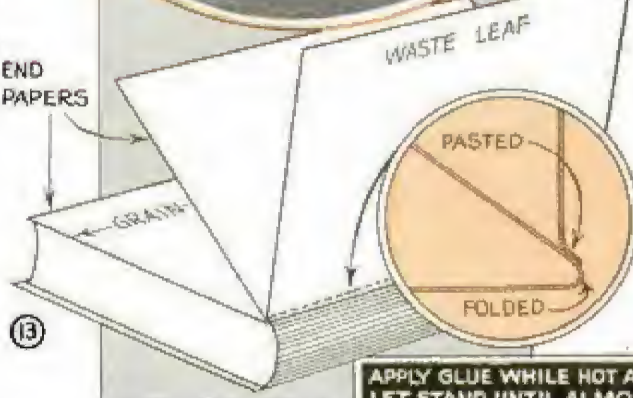


string the table with four vertical cords or tapes, fastening one end beneath the table with thumb tacks and tying the other end to the frame, Fig. 10. Thread a darning needle with No. 25 linen thread and begin sewing each section to the cords by holding the section open at the division and running the thread in and out around the cords as shown in the insert detail of Fig. No. 9. Leave 3 or 4 in. of thread extending at the starting hole. Then the second section is set in place and sewed from left to right with the same length of thread, after which the two ends are tied together. When the thread emerges at the left, or





END PAPERS



tail end of the third section, the "kettle" stitch is made, Figs. 7 and 10, to tie the three together. This is done by passing the needle behind the cord and again through the loop thus formed. The kettle stitch is made at the end of each section. Sew four sections using the "all along" stitch, Fig. 9, and then change to the "off-and-on" method, Fig. 8, for sewing the center sections of the book, finally reverting to the former stitch for sewing the last four sections. Use a square knot in joining a new length of thread so that the knot will come on the inside of the book. Where tapes are used, the threads passing across each tape are tied together by passing the needle vertically beneath them and knotting together. When the sewing is completed cut the vertical cords, hold the book firmly on the table with the back flat and strike heavy blows with a mallet along the back edge at the front and end to knock down the swelling and imbed the threads.

Testing paper for grain

12



A ACROSS GRAIN



B WITH GRAIN



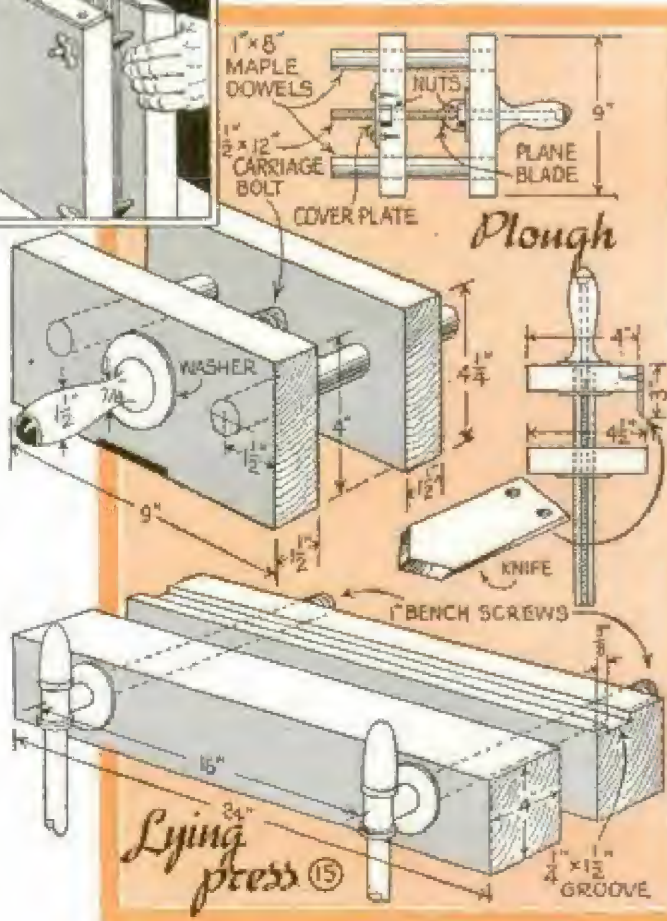
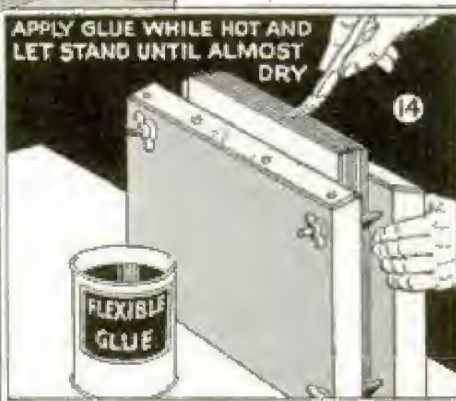
C WITH GRAIN

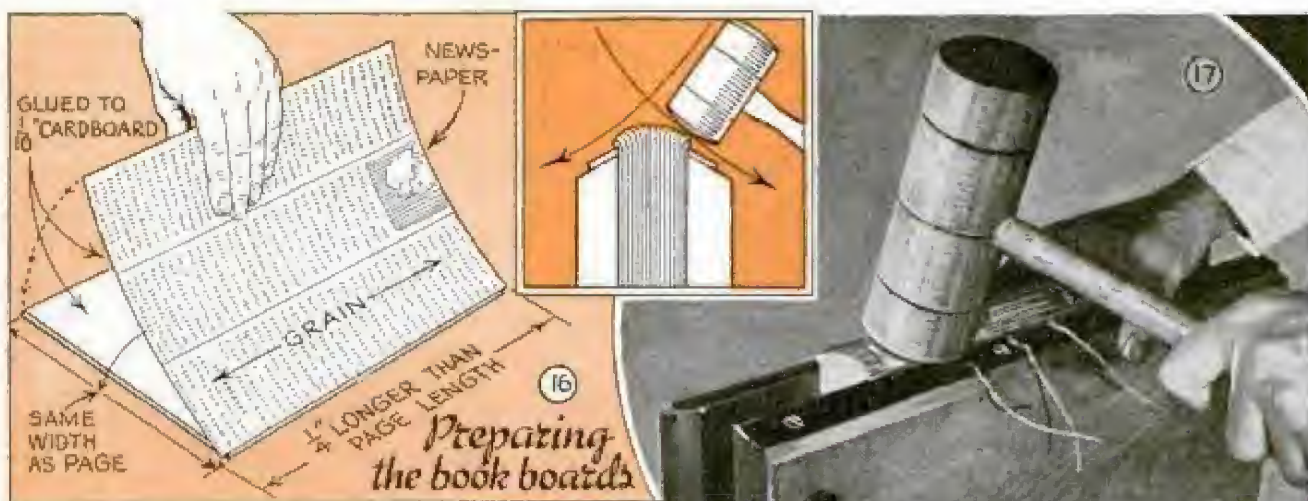


D ACROSS GRAIN

It is important that the grain of both end papers and cardboard run vertically. Fig. 12 shows how to determine this for folding the paper with the grain. The waste leaf is pasted to the outside of the folded end paper, Fig. 13. Open the book and fasten together each of the first and last three sections with a $\frac{1}{4}$ -in.-wide strip of paste down the back. Paste the end papers in the same manner and place under a heavy weight to dry for $\frac{1}{2}$ hr.

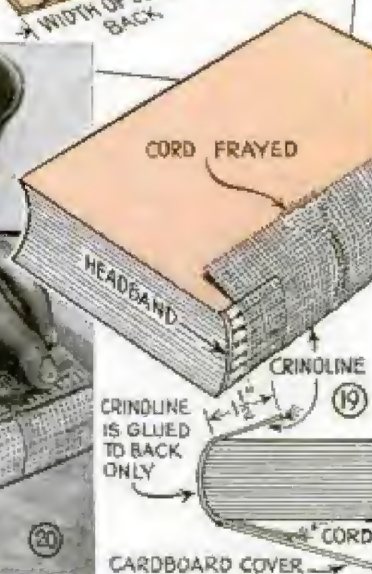
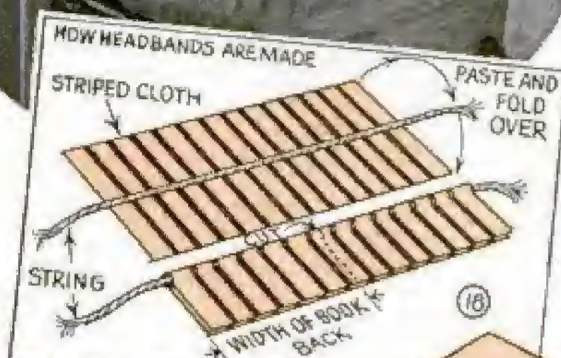
You can make your own paste by mixing powdered alum, $\frac{1}{2}$ oz., with flour, $\frac{1}{2}$ cup, adding enough water to make a thin paste. Stir to a





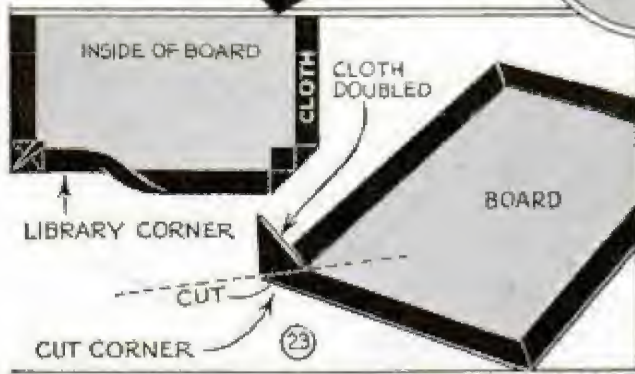
smooth consistency, add two cups of water and boil for five minutes, after which a few drops of oil of cloves are added before setting aside to cool.

Jog the book on the table to flatten the back and again clamp it in the press. Using thin "flexible" glue, which is made by adding glycerin, 1 tablespoonful, to dry glue, 4 oz., while cooking, coat the back of the book, working it in the sections well as in Fig. 14. When still tacky, the book is trimmed. Mark a straight line across the front waste leaf about $\frac{1}{8}$ in. from the head. Insert the book in the cutting press, placing it between heavy cardboards, Fig. 21, and line up the guide mark with the edge of the press. The paper is trimmed evenly by



moving the plough back and forth as the feedscrew is gradually advanced with each forward thrust. Feed the knife slowly to prevent jamming and tearing the sections.

Cut the book boards from heavy cardboard to the size given in Fig. 16. Paste a piece of newspaper to one side of each and dry under a weight. The grain of both must run vertically. Rounding and backing the book is done by first pushing in the fore edge with the thumb at the same time a drawing force is exerted with the fingers, as in Fig. 11, and then striking the back with a mallet to form "ears" along each side as in Fig. 17. Headbands of striped cloth are made as in Fig. 18 and are glued to the back at the tail and head. Apply



The title, listing name, month and year, may be typed neatly on white or colored paper and glued to the back of the book as shown above, or if you prefer, it can be lettered by hand directly on the binding, using gold or silver paint applied with a pen or small brush and followed with a coat of clear shellac to keep the lettering from rubbing off

"flexible" glue to the back and lay a piece of crinoline in the glue to overhang $1\frac{1}{2}$ in. on each side as shown in Fig. 19. Cut off the cords even with the crinoline backing and fray the ends. Several thicknesses of wax paper are placed over the front and back waste sheets and the frayed cords and crinoline are glued to the book covers as in Figs. 20 and 24. For this use plain glue which does not contain glycerin. The cover should project $\frac{1}{8}$ in. at the head and tail, leaving a groove $\frac{1}{8}$ in. wide along the back edge. Allow the book to dry thoroughly clamped in the press.

To cover the book, a piece of book cloth, which may be of buckram, paper or leather, is cut to reach completely around the book, allowing sufficient material for turning under. Make a mark down the center of the cloth on the inside and then, straddling this centerline, glue to the cloth a piece of kraft paper which is the same width and length of the book-back, including the headbands. A second piece of paper of the same width, but shorter, is glued to the back over the crinoline. Additional pieces of paper may be glued to both covers to serve as a lining as in Fig. 22. Glue the cover material first to the front board and then to the end board, and turn the cloth in over the edges of the cardboard as in Fig. 23. The sides and edges of the book are rubbed down with the rounded edge of a ruler, after which the book is covered with wax paper and clamped in the grooving end of the press where it is left for at least 12 hrs. After drying, excess cover material is trimmed away with a razor blade, leaving about $\frac{1}{2}$ in. margin around the edges. The waste leaf is then torn out and the end paper thus exposed is glued down. Wax paper is placed between the covers, and the book is once again placed in the press and clamped tightly, Fig. 25. Fig. 5 shows the completed book and an example of half binding. This process is similar as described, except that the back cover material is applied first. When dry, the material is trimmed down the sides evenly, being careful not to cut the cardboard too deeply, and completed by covering the remaining portion with cloth or paper.

Amusing Animal Toy Can Change Its Face

Wagged from side to side by a pendulum, the head of this toy has interchangeable eyes, mouth, nose and ears, which can be used in various combinations to produce unusual facial expressions. Variations of these facial parts are shown in the squared detail. All parts have dowels attached for anchoring them in place, and they all fit in holes in the face except the ears, which slip into staples on the back of the head. The base for the head is a box with the front side painted to resemble the bars of a cage. As shown in the lower left-hand detail, the head is attached off center to a dowel, which turns in a hole through the side of the box. Washers are used as spacers between the head, box and pendulum, which is fastened rigidly to the end of the dowel



inside the box. The box is painted yellow, bars black and the face white with black features.—R. L. Fairall, Los Angeles, Calif.

Glazing of Window Is Simplified with Beveled Putty Knife

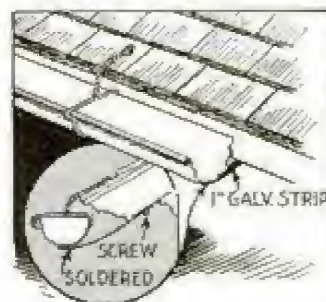
To speed up the work of putting window sash, one glazier found that grinding the blade of his putty knife at an angle enabled him to do a better job in less time. Such a blade is especially helpful in shap-

ing the putty strip into a neat joint at the corners. On the long spaces between the sash rails, the angle of the blade helps to force the loose strip into place with one stroke.—W. C. Lammey, Naperville, Ill.



Braces Steady Eave Troughs in High Winds

Eave troughs supported on wire hangers sometimes flap or vibrate in high winds, and occasionally are even torn away from the eaves. To prevent this, one home owner provided braces at intervals along the full length of the gutters. The braces are simply 1-in. strips cut from heavy galvanized iron. One end is soldered to the bottom of the trough and the other is screwed or nailed to the underside of the cornice. One brace to each 10-ft. section of trough is sufficient.



¶Covers of recipe books may be cleaned with a damp cloth without damage if they have been given a coat of thin shellac.

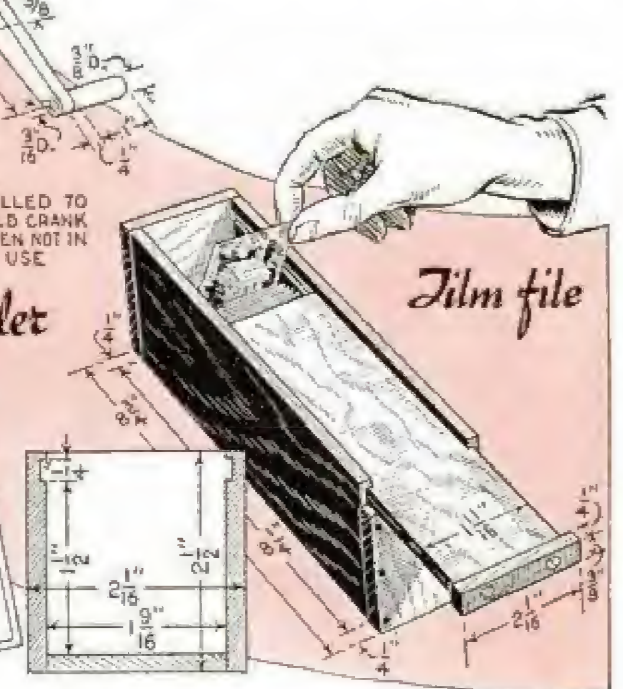
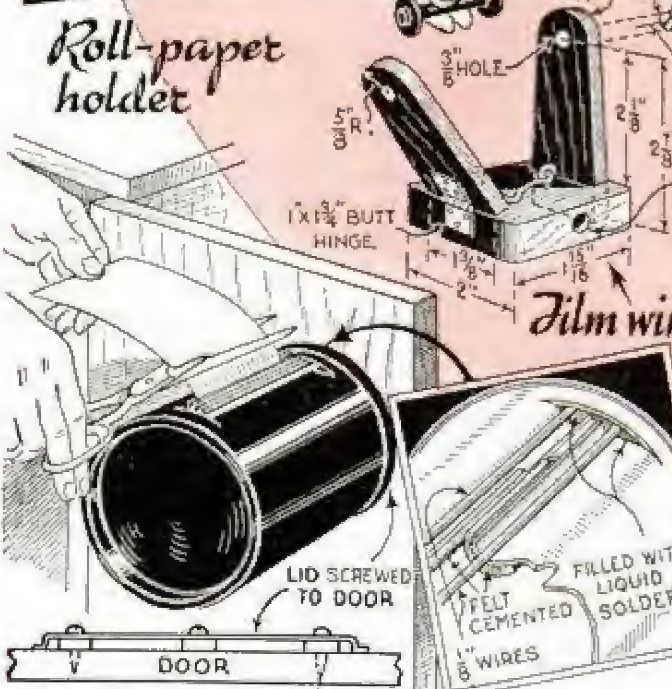
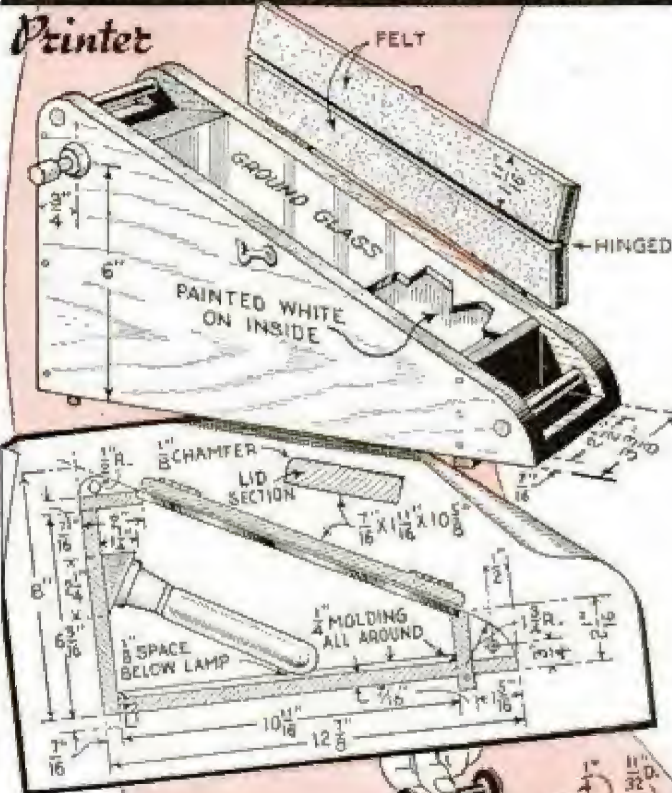
Suitcase-Type

By W. E. STEPHENS

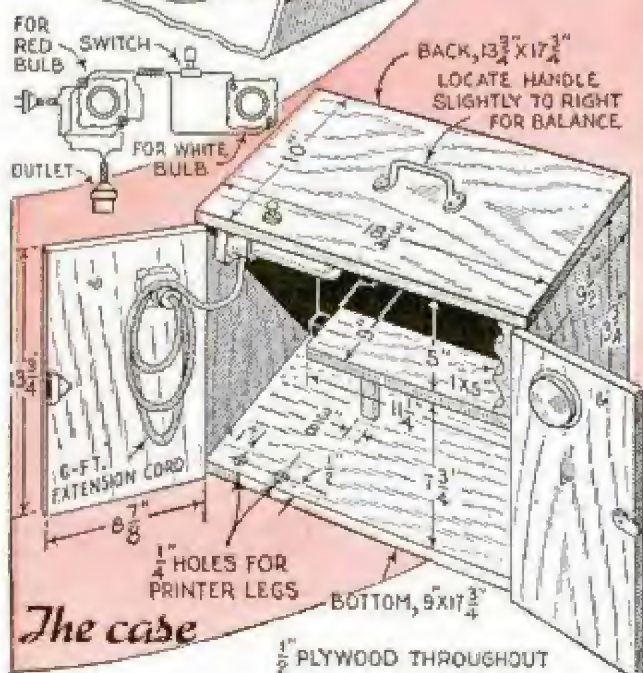
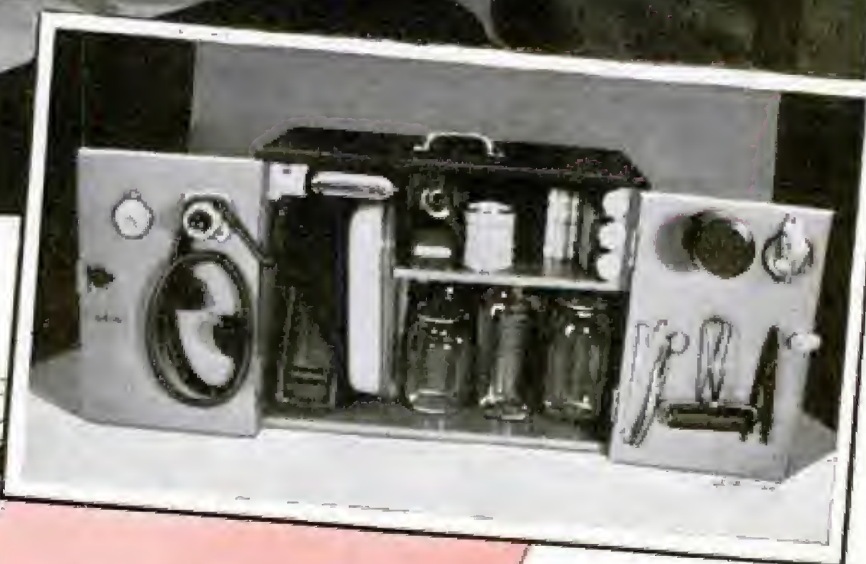


THIS compact portable cabinet which houses all necessary items for complete developing and printing, is particularly of value to the person residing in an apartment where limited space forbids a regular darkroom. Besides providing space for storing quantities of developing powders, and such standard items as a developing tank, print tongs and roller, stirring rod, thermometer, pans, etc., as shown in the photos at the right, the cabinet will also accommodate several items which can be made, namely: a printer, washer, file, winder and a holder for dispensing roll-type printing paper.

While designed expressly to care for equipment required in finishing 35-mm. film, the dimensions given for the case may be altered to suit your particular needs. A notched rack is handy for keeping film cans arranged orderly, while two flat-iron L-hooks attached to the end of the shelf will permit several developing pans to be hung vertically alongside the printer. Following the circuit diagram, the case is wired for a white bulb which is controlled with a switch mounted on the top, and a socket for a safelight is attached to the door



"DARKROOM" carried with you



in a position to clear the former when the door is closed.

The printer, which will take film as large as No. 120, is clearly detailed in the drawing at the extreme left. The film winder, which is handy for loading cartridge reels with bulk film, and the file are dimensioned to take 35-mm. film. The roll-paper holder, consisting of a press-lid can with a felt-lined opening made in the side through which the paper can be pulled as it is needed, is held to the inside of the right-hand door by means of the can cover which is attached near the top with small screws as shown. A tin baffle soldered behind the water inlet of the film washer produces a swirling motion to remove all hypo.

'Rocking Chair' Developing Tank Keeps Solution Agitated



Slipped under a cut-film developing tank, a couple of rockers provide a convenient means for keeping the developer agitated. They are sawed from 1-in. stock and should fit snugly on the tank. A gentle push now and then will keep the tank rocking during the developing period.

Notebooks Used as Photo Albums

Groups of related snapshots can be kept together in small looseleaf notebooks. The prints can be punched to match the rings in the book or pasted on the leaves with rubber cement. In this way you can select the album you wish to show and there's



much less handling of the undesired prints. Also, they are protected much better in this way than when kept loosely in a box.

Hypo Poured to Tape Line on Jug Assures Correct Solution

Time can be saved when mixing fixing solution if the jug is marked to indicate how much dry hypo to use. For a gallon jug, place a strip of adhesive tape to show the space required by 2 lbs. of hypo. Pour dry hypo into the jug up to the mark, then add water. The same idea can be applied to jugs or bottles of any size.



Notches Cut in Edge of Film for Quick Identification



Making half-circular notches in the edges of photo films to identify them, especially in three-color separation negatives,

can be done with a ten-cent paper punch. A U-shaped piece of wire soldered to one jaw of the punch, serves as a stop for the edge of the film so that a half-circular notch is made when the jaws are closed.

Strip of Scotch Tape over Lens Aids in Getting Sharp Focus

When you wish to focus your camera sharply at a certain distance, for checking the footage scale or similar test, try this method: Place a narrow strip of tape over the center of the lens and focus on an elec-



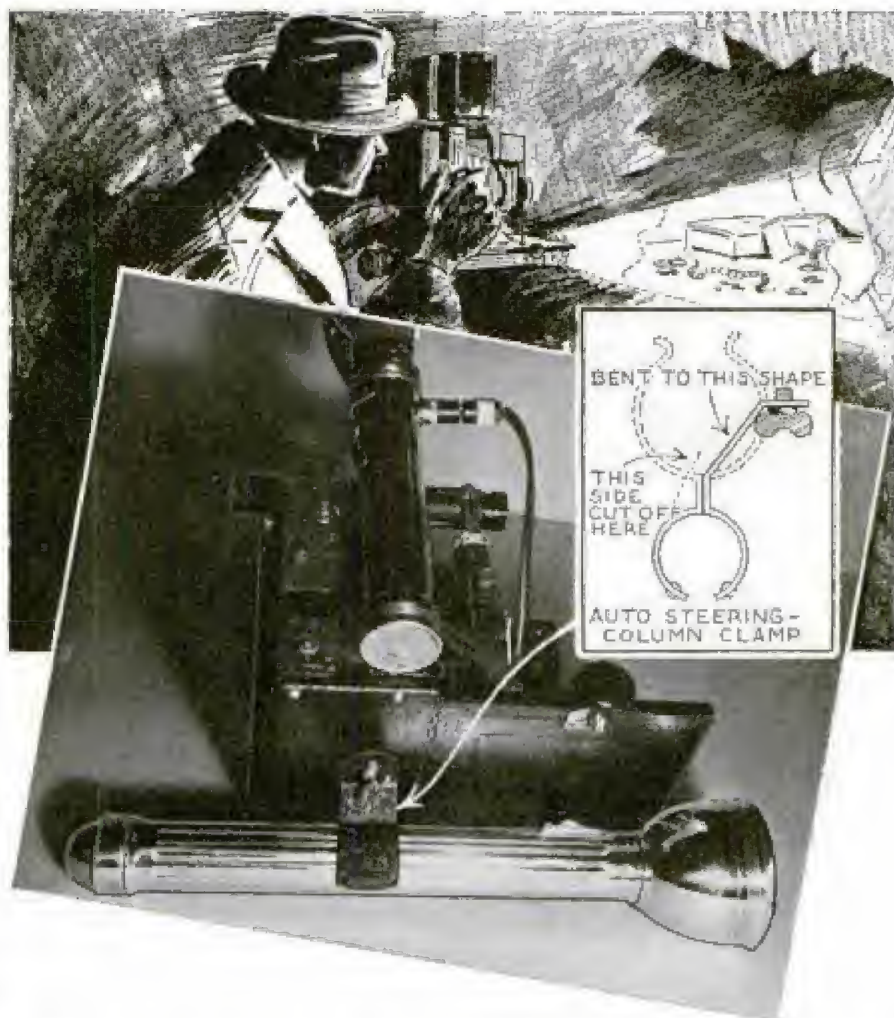
tric-light bulb. Two images of the bulb will appear on the ground glass. Rack the bellows in or out to bring the images together and when they are in exact register the bulb is in perfect focus. A clear glass bulb of low power is best for this purpose because the filament is easy to focus on.
—L. Ryan, Quincy, Mass.

Clips on Door Spring Hold Films Apart While Drying

Cut-film negatives cannot rub together and become scratched while drying on this line. Paper clamps of the type shown are threaded on a screen-door spring that has been pulled out until the loops are about $\frac{1}{2}$ in. apart. The spring is fastened between two supports and the clamps are spaced every three or four loops. The negatives will not come in contact with each other even when a strong breeze from a fan is turned on them.



Flashlight Clipped to the Camera 'Spots' Photograph to Be Taken



Police and news photographers, and others who have had trouble focusing on objects in the dark, can overcome the difficulty by clipping a flashlight to the camera. The clip used is one for holding a flashlight on the steering column of an automobile. One side of the clip is cut off and the other side bent as indicated and drilled for the wing screw that fits the tripod socket on the camera. A focusing type of flashlight should be used as it can be adjusted to cover approximately the same field as the camera.

Small Squeegee for Strip Prints

A ten-cent rubber plate scraper is a handy squeegee for applying 35-mm. strip prints to a ferrotype tin. Using the small scraper on each strip separately usually will produce a better job than using a large squeegee on several strips at once.



Slot Cut in Bench under Trimmer Swallows Paper Scraps



Paper cuttings will not pile up in your way if a slot is cut in the bench top under the trimmer. I have my trimmer screwed

to the bench so the knife is always over the hole. A waste basket on a shelf under the table catches the scraps.

—Mel Ivory, Ann Arbor, Mich.

Rubber Bands on Developer Bottle Indicate Age of Solution

By using rubber bands you can keep a simple and accurate record of the number of times a bottle of developer has been used. Slip several bands around the bottle near the top and each time a roll is developed push one of the bands down toward the bottom.



Ride Fifty Miles on a Gallon of Gas!



Run by a $\frac{1}{2}$ -hp. gas engine of the washing-machine type, this homemade motor scooter gives you plenty of fun at a safe speed and costs little to operate. Levers on handle bars control brake and throttle. Has standard ball-bearing wheels with 12 by 3-in. pneumatic tires. Complete details on making this simple scooter are given in a set of plans, Nos. 989 and 990, which will be sent to you, postpaid, upon receipt of 50 cents.

ADDITIONAL PLANS ON POPULAR SUMMER PROJECTS

OUTDOOR FIREPLACES—917: Several simple, but practical types, to match other items in rock garden. 25c.

LAWN CHAIR—529: Plain sawed from $\frac{3}{4}$ -in. stock. Easily made with hand tools. 25c.

ORNAMENTAL WOOD FENCES—640: Five artistic designs for standard wood stock. 25c.

CIRCULAR ARBOR AND GATE—637: Popular style anyone can build. 25c.

LAWN AND GARDEN FURNITURE—920 to 922 incl.: Collection of designs for arbor-and-seat combinations and swings. 3 prints 75c.

TRELLIS SUGGESTIONS—639: Six types that will help beautify your home. 25c.

BARROW CHAIRS—924: Two styles. Built for comfort. Simple construction. 25c.

DUTCH WINDMILL AND WATER WHEEL—911: Mill, 40 in. high. Small water wheel. 25c.

LOG-CABIN CONSTRUCTION—916: Two floor plans. Shows how to make corner joints. 25c.

Any six individual plans (not sets of plans) will be sent upon receipt of \$1.00

Also, be sure to get our handy reference catalog listing 400 plans. This will be included free with your order if specified, or sent separately for 3 cents to cover mailing

Address—Popular Mechanics Plan Service, 200 East Ontario Street, Chicago, Ill.



"ZIP," MODEL RACING YACHT—880 to 883: Marblehead Class, 50 in. long, 800 sq. in. of sail. Bread-and-butter hull construction. Plans include full-size lift templates. 4 prints \$1.00.

SPEEDY MODEL BOAT—965 to 968: 32-in. boat powered by midget gas engine develops 20 to 25 m.p.h. on circular course. 4 prints \$1.



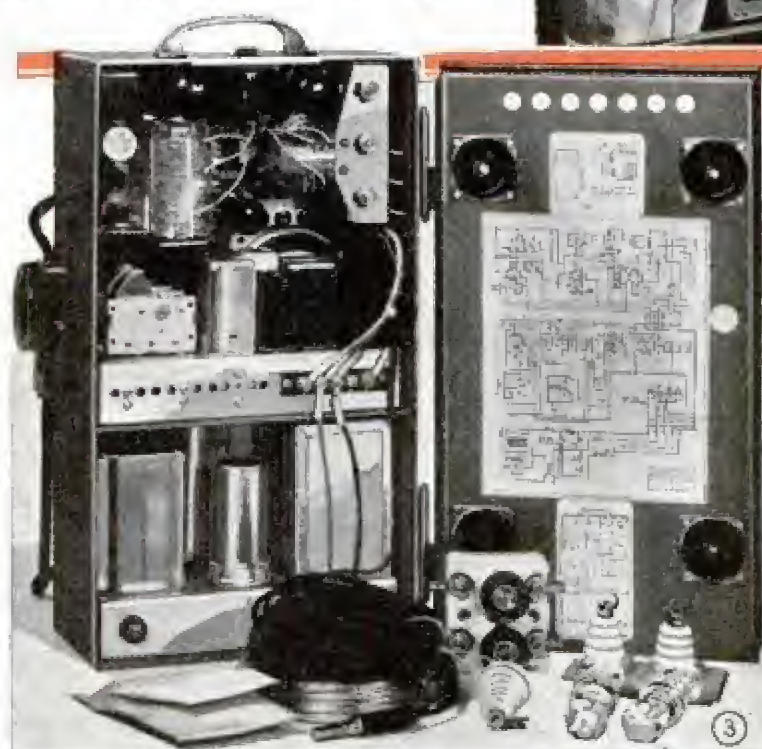
ULTRA-COMPACT *Marine* RADIOPHONE

COMPLETE in one sturdy seaworthy unit, and weighing only twenty-nine pounds fully equipped, this efficient portable radio station includes a 3-channel crystal-controlled marine-band transmitter, broadcast and marine-band receiver and a power supply, developed especially for two-way marine radiotelephone service.

Photo (1) shows transmitter band-switching control and all receiver tuning controls arranged conveniently on the front panel. Easily installed for operation on a wall or bulkhead as indicated in photo (2), and economical on battery drain, this ultra-compact



marine phone is ideal for small craft where all available space is at a premium. A single-button carbon microphone, of the press-to-talk type, mounts on the side of the cabinet. The lower photo shows rear view with door



opened, which permits easy access to all stages when inspection or adjustments are required. The following metal-type tubes are employed in the transmitter: one 6V6 oscillator, one 6L6 R.F. power amplifier and one 6L6 modulator; the receiver uses one each 6K8, first detector and oscillator; 6SK7, I.F. amp.; 6SQ7, second detector-ave and audio; 6V6 output.

High voltage is provided by a synchronous vibrator-type of rectifier; a carefully designed filter is built into this power unit, which operates on a 12-volt storage battery. Similar models are available for 6-volt battery operation.

CAPACITY-OPERATED

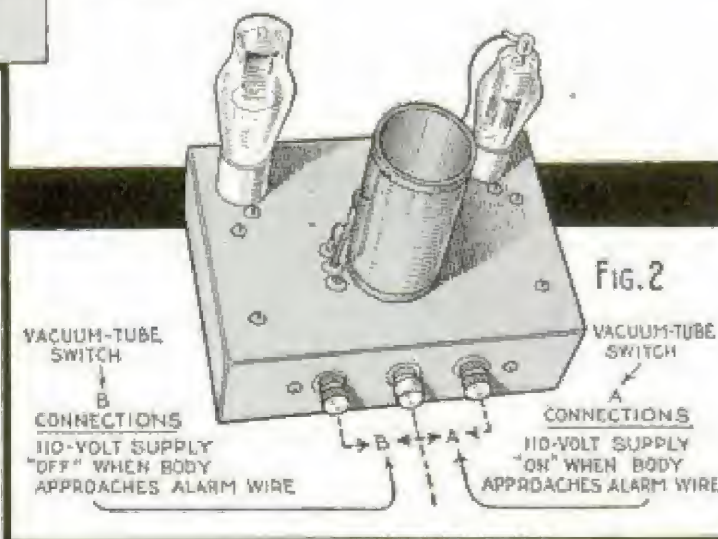
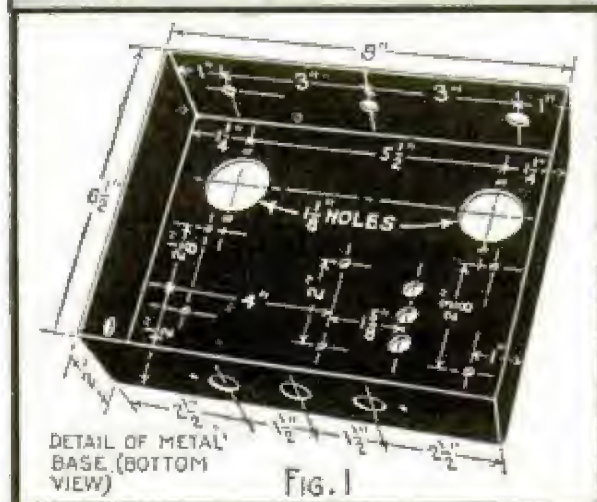


THIS sensitive capacity-operated vacuum-tube relay is easy to construct from ordinary inexpensive radio parts. Capacity added to, or removed from, the immediate vicinity of a short alarm wire operates the relay either in broad daylight or darkness. The capacity effect takes place at the approach or withdrawal of a person or passing object, therefore this versatile instrument can be

connected to ring alarm bells, light floodlights, switch on electrically driven door-opening devices, window displays, or cut off radio while phoning, as illustrated in sketches A, B, C, and D, and for many other useful applications. Furthermore, this unit is provided with binding posts wired to supply 110-volts

for operating any electrical device which the vacuum-tube switch controls.

The relay unit is adjusted with a single control and may be operated from any 110-volt a.c. outlet. A type-77 tube is used as an oscillator with the alarm wire forming a part of the tuned circuit; this tube in turn controls the type-43 power output, or "trigger" tube, which is connected directly to the relay.

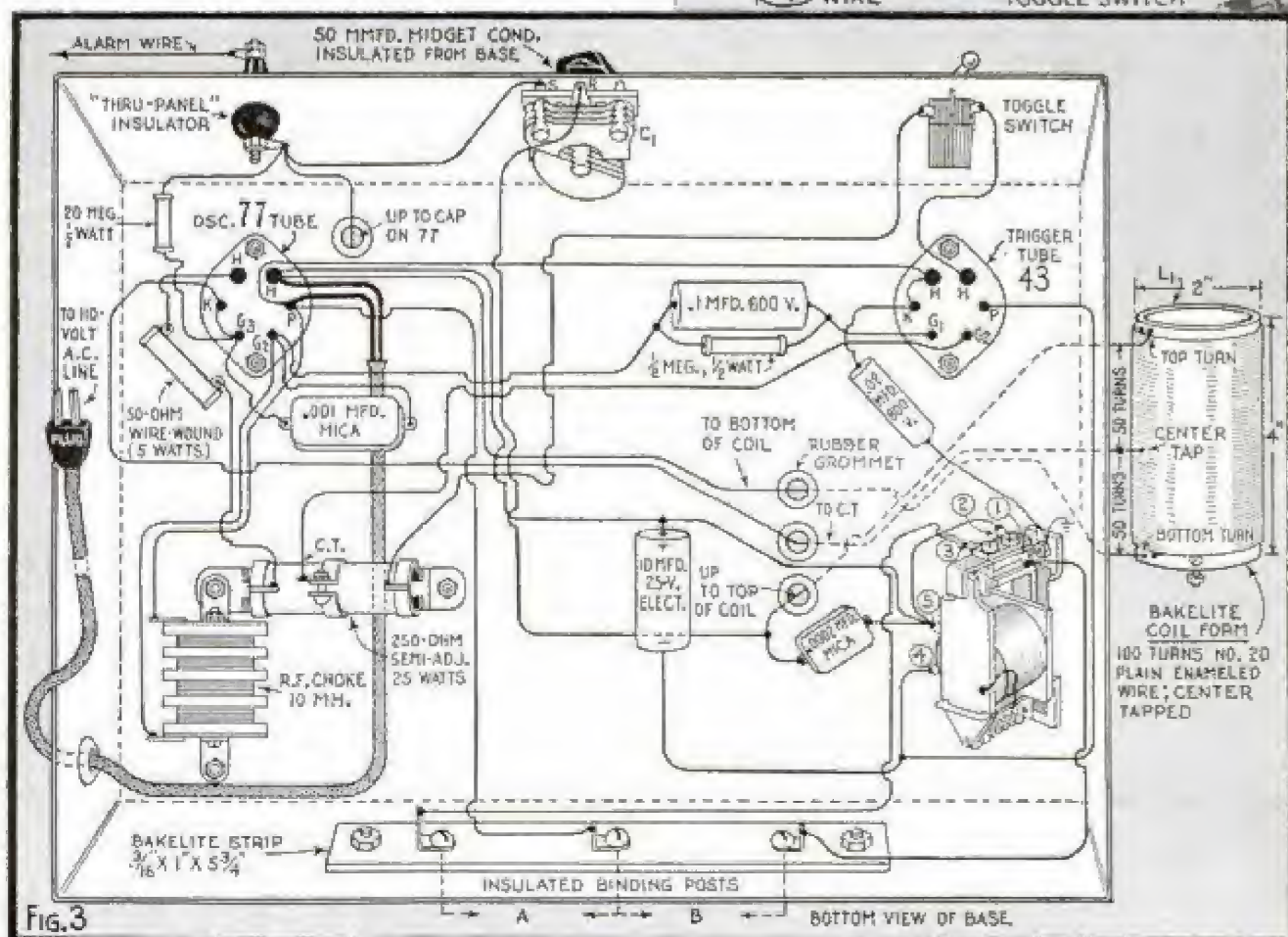


VACUUM-TUBE SWITCH

Complete details for the simple sheet-metal base are given in Fig. 1. The relay is a standard inexpensive 2,500-ohm coil s.p.d.t. type with silver contacts to carry 5 amp. of non-inductive a.c. at 115 volts.

A simplified wiring diagram is shown in Fig. 3 and the schematic circuit diagram appears in Fig. 4. The coil (L_1) is close-wound, as detailed in Fig. 3, on a 2-in. Bakelite tube, 4 in. long. Two small holes, $\frac{1}{4}$ in. apart and $\frac{1}{4}$ in. away from the edge, should be drilled at each end for fastening the beginning and end turns. After 50 turns have been wound, tightly twist a loop of about 6 in. to make the center-tap lead and then continue winding another 50 turns in the same clockwise direction; the completed coil may be varnished, or lacquered if desired. When wiring the circuit keep all wires as short as practical and use "spaghetti" insulating tubing on the coil leads that go down through the base; also carefully insulate the binding posts, and tuning condenser (C_1), from the metal base. Two fiber shouldered-type washers

(Continued to page 135A)



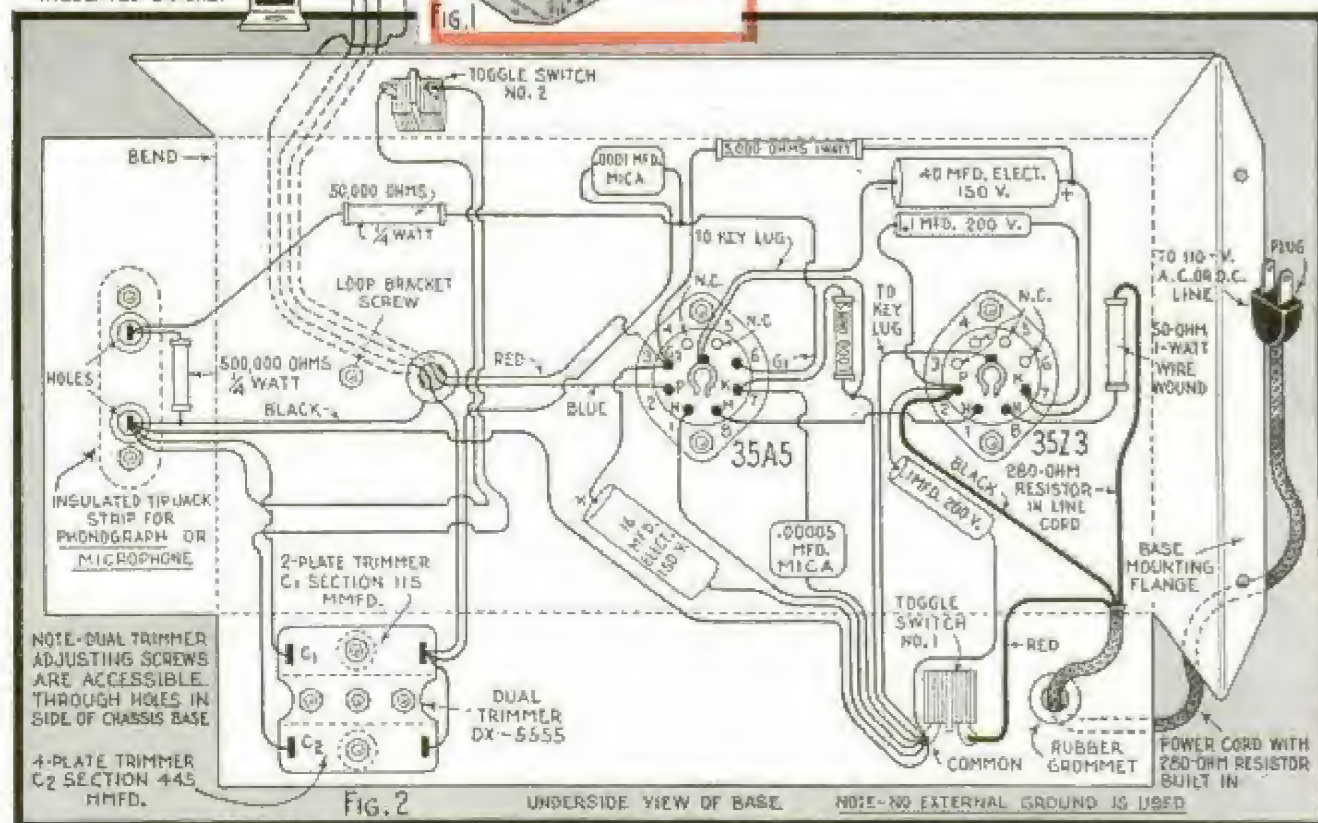
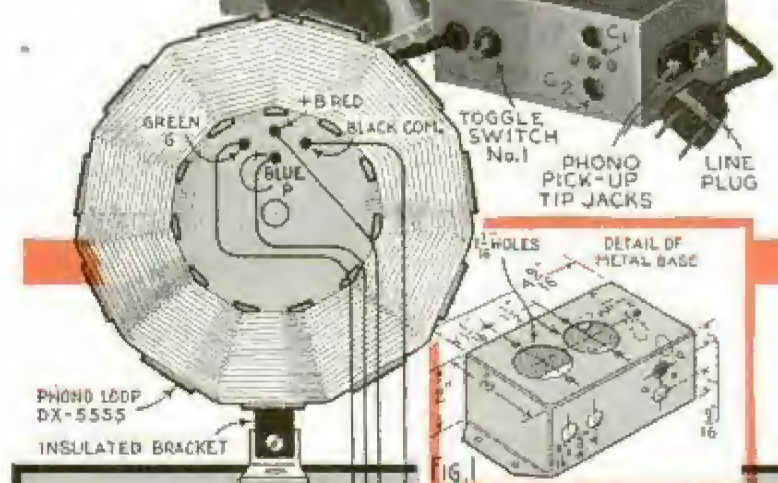
Loop-Operated "Phantom" Record Player



ONLY a few radio parts are required to build this improved model of the popular 2-tube "phantom" record player R-270 which appeared in the September, 1939, issue. A marked directional effect and greater efficiency obtained by using the phono-loop are helpful with the newer receivers.

Those who built the original model can change over to loop operation easily by making a few minor adjustments in the circuit and substituting the loop for the oscillator coil. Complete details of the metal base are shown in Fig. 1; except for several additional holes the base is unchanged. Photos (A) and (B), and simplified wiring diagram, Fig. 2, clearly illustrate construction details, and the schematic circuit diagram is given in Fig. 3. All parts are available from radio mail-order firms and the parts values are given in the diagrams. The DX Products company type phono-loop and dual trimmer condenser, plus the extra toggle switch No. 2, are the only parts required not previously specified in R-270. It will be noted that the only original fixed condensers not

(Continued to page 137A)

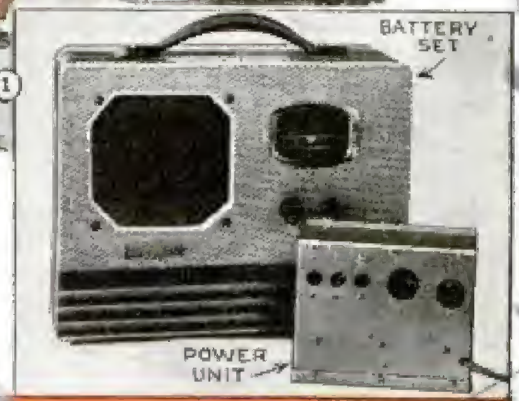


Hints for RADIO EXPERIMENTERS



(1) You can use this compact power unit to operate any portable battery receiver from a 6-volt "hot shot" battery, or, the storage battery in your car, by clipping one terminal on ammeter and grounding the other. In auto, a pole-type antenna would be employed. Power unit supplies all voltages at low drain

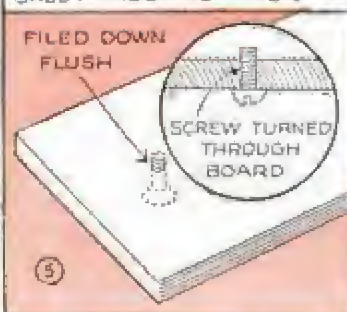
(2) Ultra-low-loss polysterene crystal holder in horizontal-mounting type



(6) Compact panel-mounting type heavy-duty relays in s.p.s.t. and s.p.d.t. varieties for radio amateurs and experimenters. (7) Old hot-water tank sunk vertically as shown, and kept filled with water, makes excellent radio ground even in dry sandy locations



(3) Uni-directional microphone reduces background noise; the four-side call-letter plate is optional. (4) Piece of corrugated sheet metal makes handy screw tray for workbench. (5) Simple method for holding small machine or wood screws to shorten by filing



"Camera" Radio Set for Hikers



Available either with carrying handle or shoulder strap, this tiny radio receiver has built-in batteries, antenna and dynamic speaker. It employs the new miniature tubes in a superheterodyne circuit, and tunes the standard broadcast band.

Portable Has Detachable Antenna

This universal portable radio receiver employs a detachable loop antenna that may be fastened to the window of an auto-



mobile, steel building, airplane or train where steel construction reduces signal strength. Set works on 110-volt a.c. or d.c. current or on a self-contained battery pack.

Vertical Loop for Television

Built-in vertical loop television receiving antenna is made possible by a recently proposed system of vertical wave transmission. This system is claimed to reduce diathermy and noise interference, trouble-



some in the reception of horizontally polarized television signals now being received on dipole antennas installed on roofs. The directional property of the loop is under the control of the operator.

Blueprints covering radio construction articles in this and past issues are available for 25 cents each. Original material lists, with names of manufacturers and dealers, can be obtained from our Radio Department upon receipt of postage.

NEXT MONTH—How to Build a Pack Set for Camp or Boat. A low-cost 3-tube battery-operated "knockabout" super built into a revamped 49-cent overnight bag. This case is fitted with a shoulder strap and hand-wound loop antenna. Uses standard I.F. transformers; operates on two 45-volt B-batteries and four flashlight cells.



SHOP NOTES

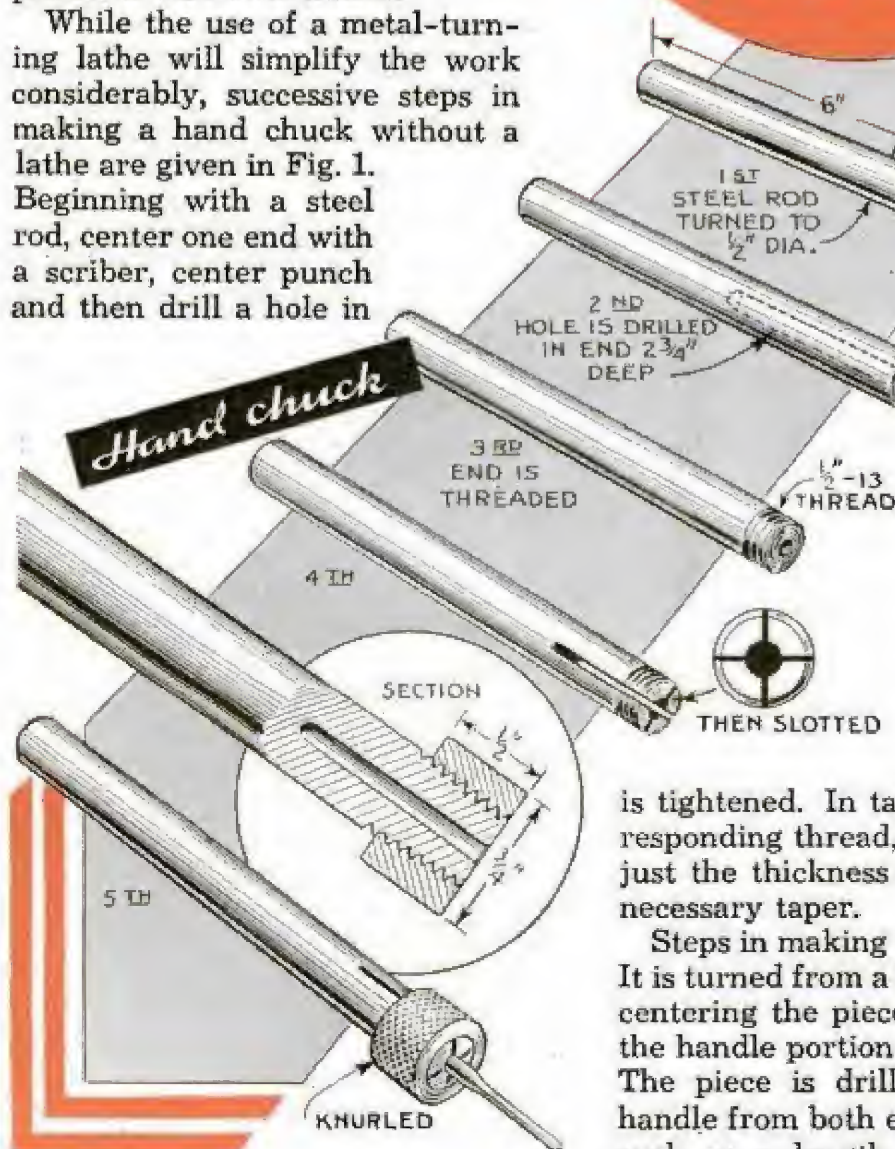
Make your own

By J. B. MULLEN

ESPECIALLY useful in model-making and in other intricate work, a hand chuck for tiny twist drills, and a pin vise to grip extremely small parts while working on them, are two handy tools which can be made from a few pieces of cold-rolled steel.

While the use of a metal-turning lathe will simplify the work considerably, successive steps in making a hand chuck without a lathe are given in Fig. 1. Beginning with a steel rod, center one end with a scribe, center punch and then drill a hole in

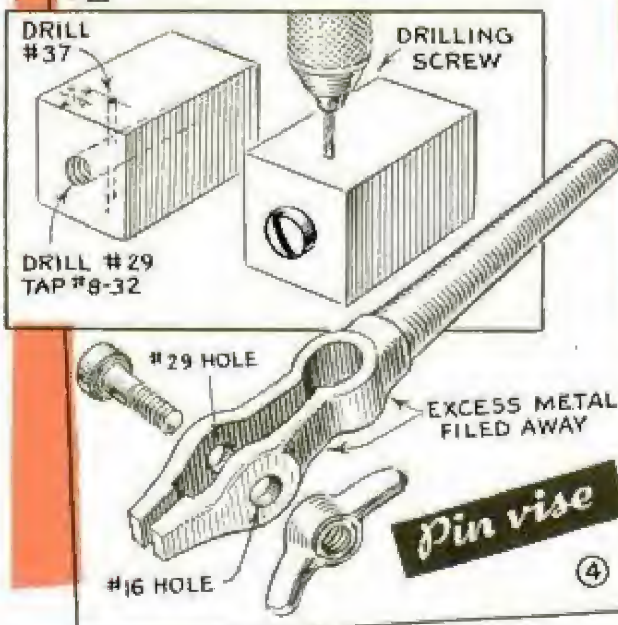
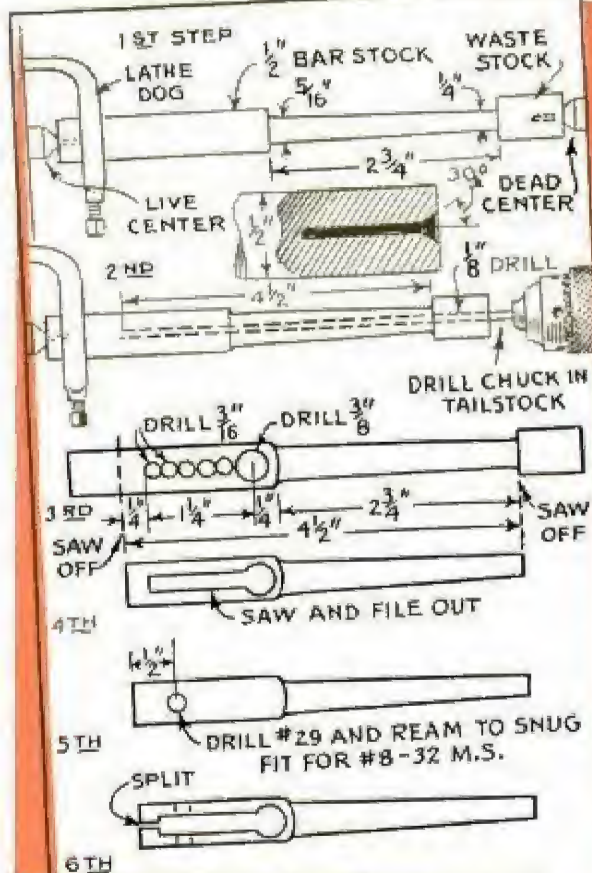
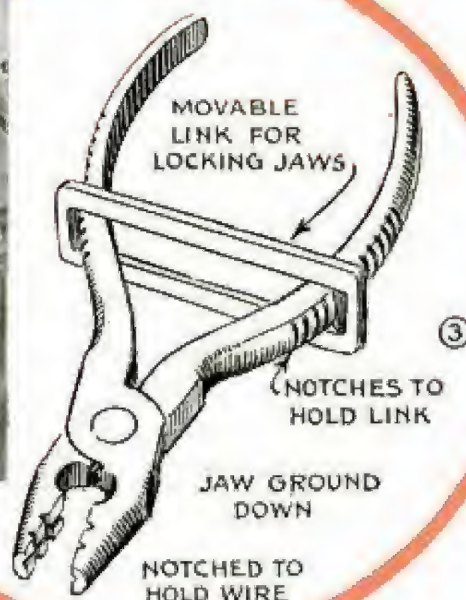
HAND CHUCKS and PIN VISES



the end, using a drill the same size as the tool which the chuck is to hold. Threads are cut on the end for a distance equal to the thickness of the die, after which the rod is slotted. Do not cut threads beyond the thickness of the die as the taper of the thread provides the clamping action of the chuck when the knurled collet

is tightened. In tapping the collet with a corresponding thread, the tap likewise must enter just the thickness of the collet to provide the necessary taper.

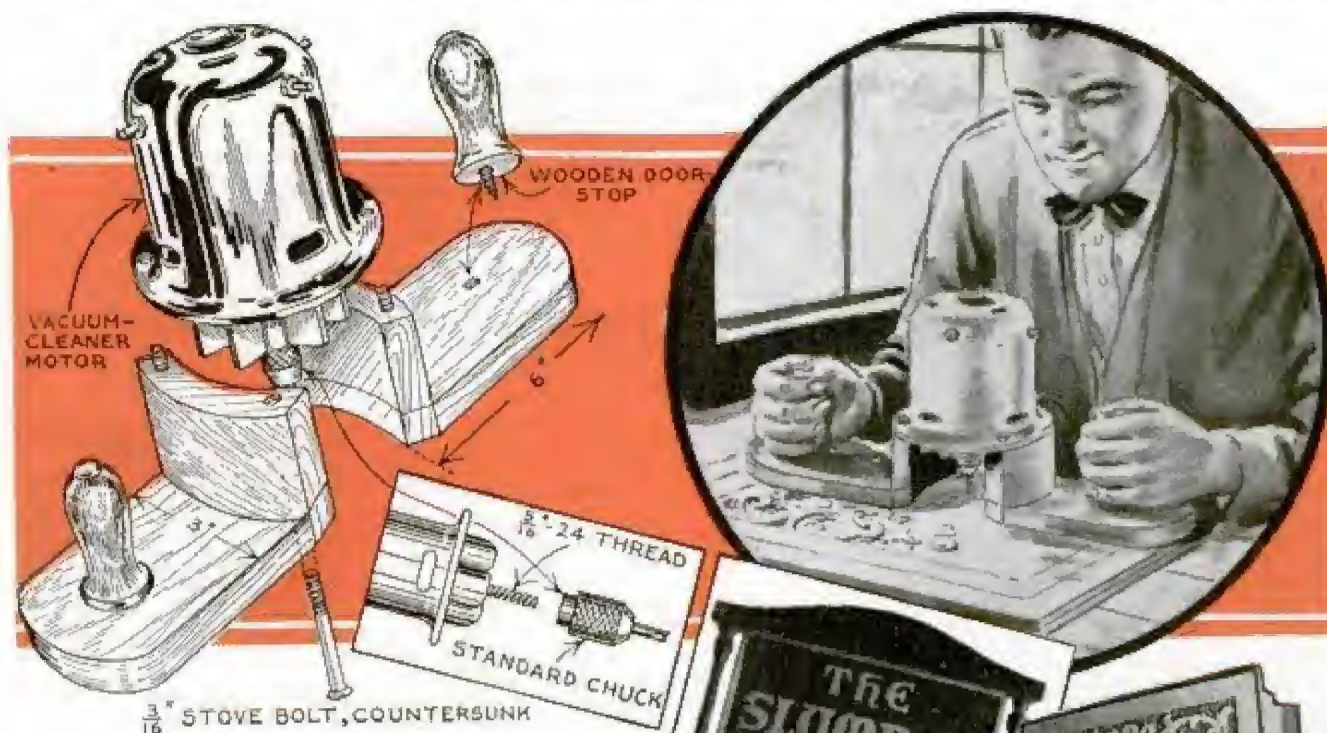
Steps in making a pin vise are given in Fig. 4. It is turned from a length of square steel. After centering the piece as shown in the first step, the handle portion of the vise is turned to size. The piece is drilled lengthwise through the handle from both ends. The hole permits work such as a length of wire or rod to extend



through the handle. While drilling, the piece is held in a chuck or supported with a steadyrest as in Fig. 2. Then it is removed from the lathe and a series of holes are drilled as shown in the third step, after which the opening is filed square and the waste is cut from the ends. At right angles to this slot, holes are drilled through the side for a machine screw which is fitted with a wing nut. The shoulder of the screw fits snugly while the threaded end passes through a hole in the opposite side. This is shown clearly in the completed view of the vise. The insert detail in Fig. 4 shows a jig for drilling a small hole through the shoulder of the adjusting screw accurately. The jig is merely a small steel block drilled and tapped to receive the screw after which it is an easy matter to drill a small hole at right angles to pass through the screw. The pin vise is completed by splitting the jaws apart with a hacksaw and filing smooth.

Another serviceable pin vise can be improvised quickly from a pair of inexpensive side-cutting, flat-jaw pliers as in Fig. 3. A link to engage in notches filed in the handles provides a means of clamping the jaws. The link is cut from a piece of steel after which it is slotted to slip only part way over the handles. The cutting edges are ground away, of course, and a hole is drilled through the rivet of the pliers to permit long work to be clamped lengthwise, while V-shaped notches, filed crosswise in the jaws, allow small work to be held vertically.

Hand Router Carves Intricate Designs in Relief



This router will handle regular grooving jobs with ease, and after a little practice in manipulating the tool, you will be able to carve intricate designs similar to the two examples given. To make the router, all you need is an old vacuum-cleaner motor, a standard chuck and some wood to make the mounting or base for the motor. The projecting end of the motor shaft is threaded to take the chuck, and the fan is left on so that it produces a blast of air to blow away wood dust made by the router bit. Height of the vertical pieces of the base will depend on the combined

length of the motor shaft and the chuck. A couple of wooden doorstops provide hand grips for manipulating the router. Cutting depth of the router bit is adjusted by the depth to which it is inserted into the chuck.



Two Alterations That Will Improve Arc-Soldering Outfits

If you have an electric arc-soldering outfit, try using a wedge-shaped end on the carbon. It will last longer than a point and is easier to shape. Also, on outfits of this type a single wrapping of tin or thin copper around the carbon where the holder contacts it helps to assure good electrical contact.

—W. C. Wilhite, Carlinville, Ill.

☞As most acids are measured out in small quantities, in some cases it will pay to keep concentrated acids in small bottles having medicine droppers in the caps.

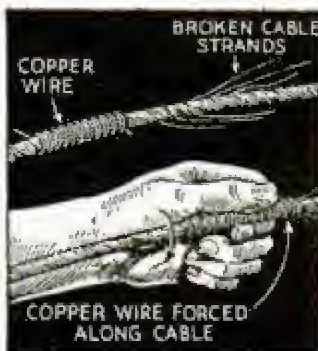


Locked Panel on Parts Cabinet Keeps Contents Safe



To protect the contents of a small-parts cabinet against petty thieves, one shop worker provided his cabinet with a sliding panel front which could be padlocked to the top of the bench. Grooved uprights to take a plywood panel were riveted to the sides of the cabinet, which was screwed firmly to the bench. A window-sash weight was then attached to the panel to raise it automatically when released.

Frayed Cable Is Easy to Repair with Copper-Wire Wrapping



Where flexible wire cables, which are not subjected to heavy strain, have a few broken strands, and the flexibility must be maintained by any repair method, try a sleeve of copper wire. The wire is

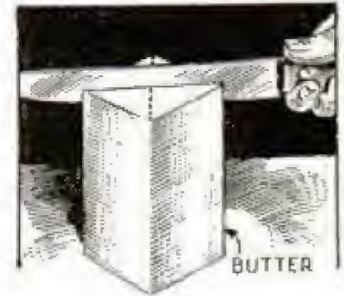
wrapped tightly around the cable above the portion where the strands are broken, after which it is "screwed" down over this portion, and both ends of the wire are sol-

dered to hold it in position. This repair adds a slight thickness to the cable but holds the frayed edges down and prevents them from being bent out, which might cause them to jam inside of a housing or sheathed pulley through which it runs. Cables subjected to considerable strain, especially if weighted, should be renewed when the strands start to break.

Diagonal Cuts Divide Butter Print into Four Equal Parts

A grocer who did not stock butter prints in less than 1-lb. size found that he could fill an occasional order for ¼-lb. prints by dividing the larger ones.

This was done by making two diagonal cuts as indicated. When done carefully, the four pieces obtained will be almost identical in weight.



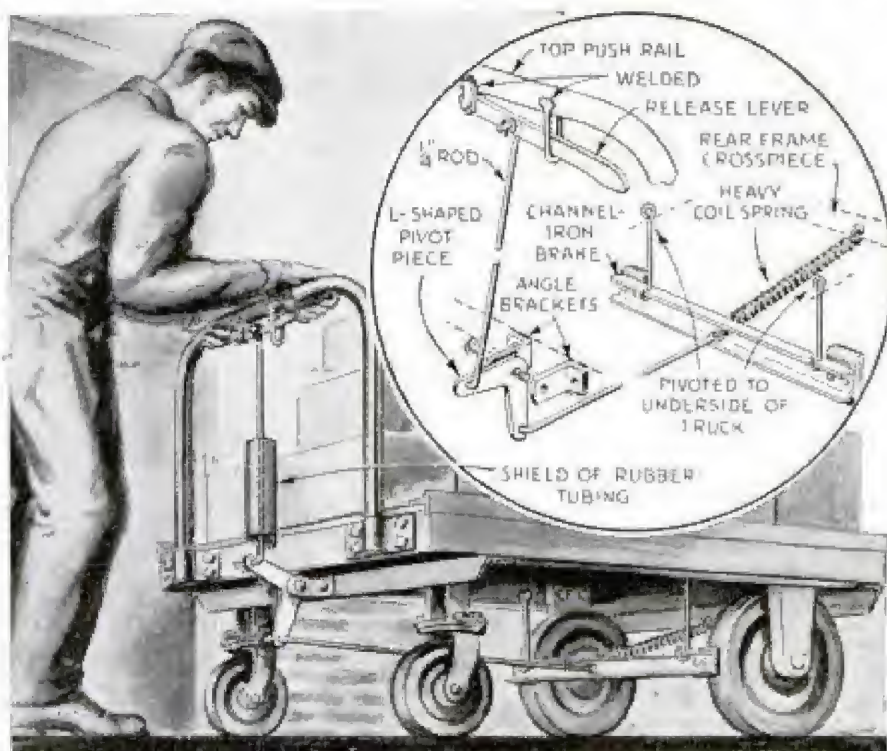
Ice Kept from Shifting in Truck by Angle Irons on Floor

After a large ice truck had overturned on a sharp curve because heavy ice cakes shifted to one side, the owner put lengths of angle iron on the bottom of the truck body. The ice cakes were centered in loading so that the slight melting would anchor them against sidesway.



Brake Holds Shop Truck When Unattended

Shop hand trucks fitted with brake systems similar to the one shown do not have to be blocked when loaded and left, and there is no possibility of forgetting to put on the brakes as they are always set. The brakes are released by a small lever, which is located conveniently on the handle or push rail and held in the depressed position while pushing the truck. The circular detail shows how the brake system is assembled, using a spring and a linkage to the operating lever.—W. K. Crosson, Detroit, Mich.



Headset for Cradle Telephone Leaves Both Hands Free



Having to take down notes and memos while using a cradle-type telephone, one office worker rigged up a headset for it so that he could have the use of both hands. A pair of old radio headphones were used, one of the phones being removed and the bracket that held it slipped into holes in the cradle-phone receiver. Not being connected, the other phone of the headset tended to balance the weight of the receiver and, at the same time, served to cover the ear and help keep out outside disturbances.

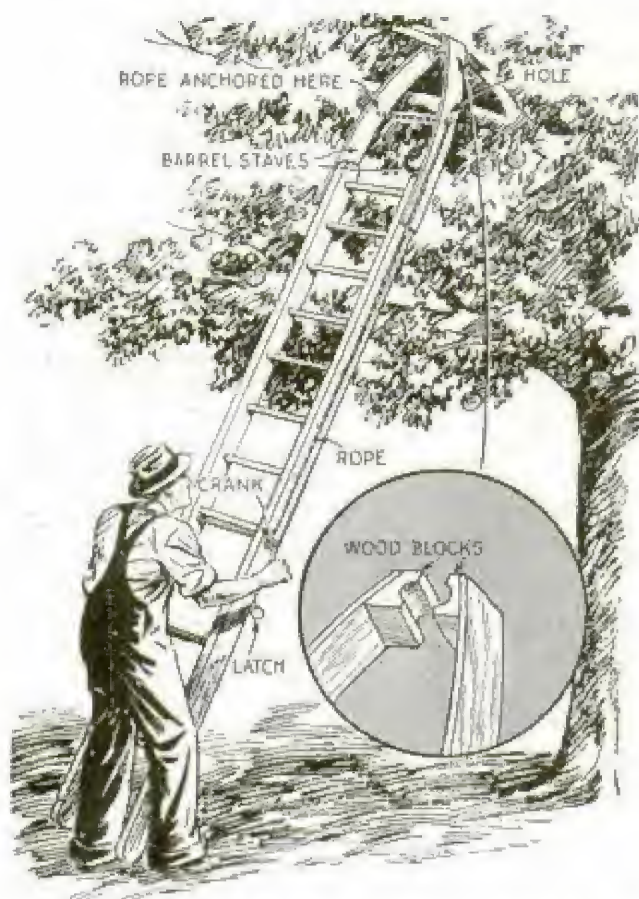
—Fred Delavan, Philadelphia, Pa.

Chattering of Slender Boring Bar Is Avoided by Encasing It in a Tube

Chatter that is usually present when boring small deep holes can be avoided by encasing the bar in a copper tube. If necessary, the tube is crimped around the bar to give a tight fit, then the assembly is clamped in the lathe tool holder. The tube must extend as close as possible to the cutting edge. This arrangement gives the tool the advantage of a large bar with the size of a small cutting tip.

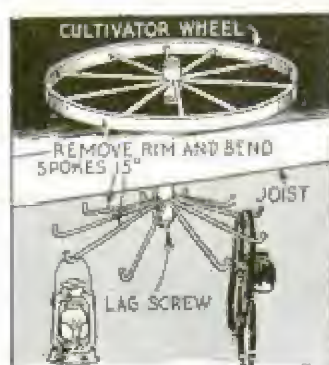


Orchard Ladder Clamps to Limb of a Fruit Tree



To assure safety in using a ladder in an orchard, one fruit grower attached a pair of heavy barrel staves to the top and arranged them so that they could be operated like a pair of pincers by means of a rope and crank. The rope was anchored to the center of one stave, drawn through a hole in the center of the other and then wrapped around a crank rod inserted through holes in the lower portion of the ladder. In use, the staves were made to engage a limb of the tree and the crank rod turned to draw up the rope. An anchored loop or ring near the crank handle served to hold it at the desired tension.

Handy Hook Assembly for Barn from Rimless Wheel

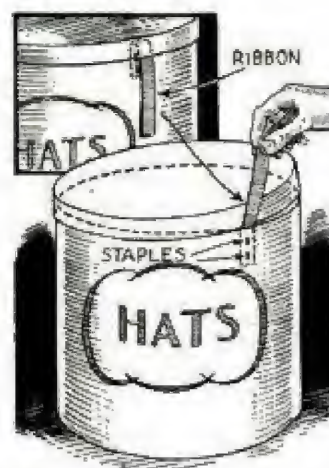


An old cultivator wheel with the rim removed and the spokes bent upward at the ends as shown, provides a handy rotating assembly of hooks for use in a barn. The assembly is

pivoted to a ceiling joist with a long lag screw. To do this, drive a hardwood plug in the hub and fasten it in place with a wood screw running through the oil hole in the hub. Then drill through the plug to take the lag screw.

Ribbon Stapled in Hat Box Lifts Cover Easily

Annoyed by the difficulty of removing lids from round hat boxes, a merchant stapled a strip of cheap ribbon to each box so it hangs over the edge when the cover is replaced. To remove the lid quickly, the ribbon is pulled upward.



Furrow Chain Aids in Steering Tractor When Plowing

Here is a simple guide for your general-purpose tractor that eases the tension of constantly watching the furrow wheel when plowing. It consists of a bar of wood or iron bolted to the forward end of the tractor frame and projecting at right angles to a distance slightly more than half the normal rear-wheel tread. Drill several small holes near the outer end so you can attach the chain at just the right point.



CHROMIUM PLATING *Simplified*

Lever to immerse anode in the plating solution gives accurate current control

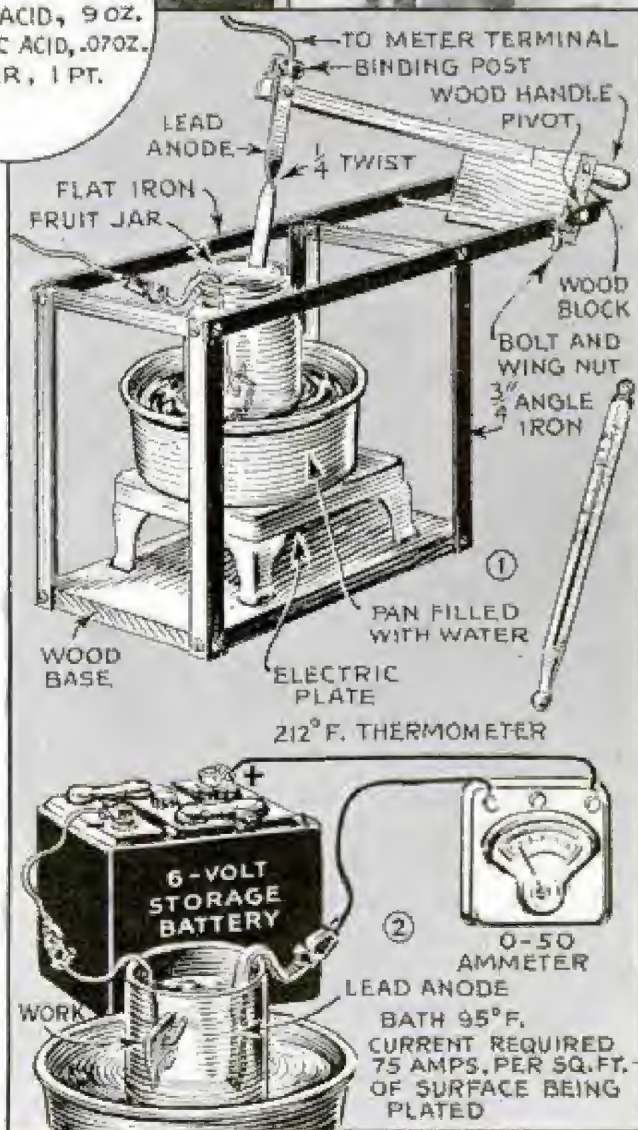
By Alexander Maxwell

WHERE an exceptionally hard surface is needed for wear-resisting quality, such as cutting edges of tools, chromium plating with subsequent honing has been found highly successful. Compared to a diamond, which for the sake of comparison we will rate at a hardness of ten, and tool steel, which ranges from four to seven, chromium is about nine. Applied directly to steel, it enables a tool to be used about four times as long as normally possible before sharpening.

A convenient chromium-plating arrangement for small work is shown in Figs. 1 and 2. A wood or metal framework on a wood base holds a gas or electric plate for heating a pan or pail of water in which a glass or stone container is set. The latter contains the plating solution, which is kept at uniform temperature by the hot water. Spacing blocks are provided under the jar to avoid direct contact with the pan. The framework also supports an anode holder, which is pivoted so that the anode can be immersed slowly into the plating solution until the correct current flow is registered on a 0-50 ammeter. When the anode, which is lead, has been immersed as far as required, the anode handle is locked in position by turning a wing nut on the frame until plating has been completed. Where considerable plating is done, a switch controlled by a thermostat in the water bath has been found helpful in turning the electric plate on and off to maintain uniform temperature automatically. While plating,



CHROMIUM-
PLATING SOLUTION
CHROMIC ACID, 9 OZ.
SULPHURIC ACID, .07 OZ.
WATER, 1 PT.





CHEMICALS MUST BE
PROPORTIONED CAREFULLY

CURRENT REQUIREMENTS FOR
SURFACE AREA
(at 75 amps. per sq. ft.)

1 sq. in. requires	0.52 amp.
2 "	1.04 "
3 "	1.56 "
4 "	2.08 "
5 "	2.6 "
6 "	3.12 "
7 "	3.64 "
8 "	4.16 "
9 "	4.68 "
10 "	5.2 "
20 "	10.4 "
30 "	15.6 "
40 "	20.8 "
50 "	26.0 "
60 "	31.2 "
70 "	36.4 "
80 "	41.6 "
90 "	46.8 "
100 "	50.2 "

④

procedure necessary with most plating baths is not essential with chromium, as the acid itself is better than any soap or solvent available. For rust removal a bath of hydrochloric acid and water (see formula

under Fig. 5) is prepared, and this is heated in a pan of water to a temperature of 120° F., after which the rusty objects are immersed. Light coatings of rust are dissolved in about 10 minutes, but an hour or so may be necessary for bad cases. Then scrub and rinse well with water.

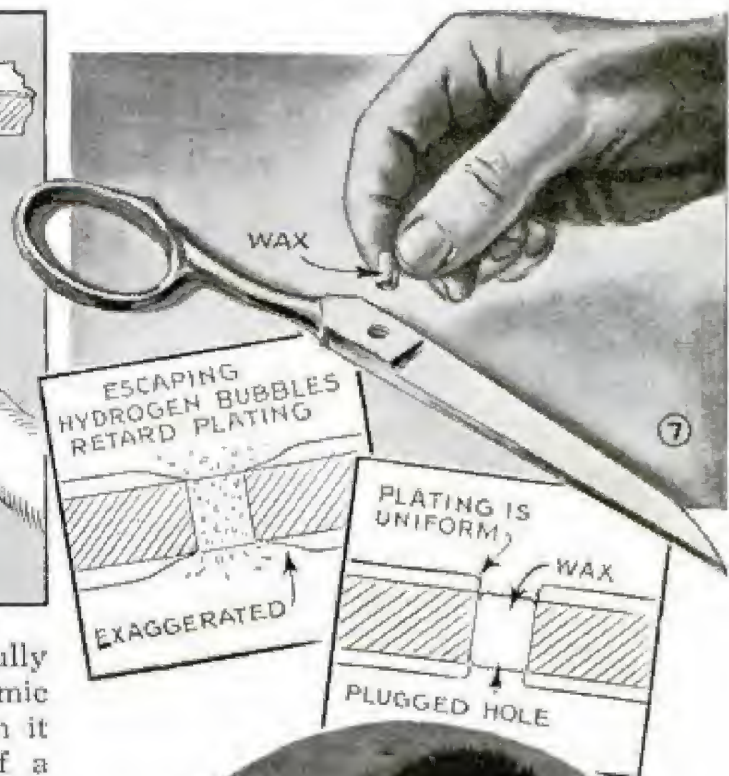
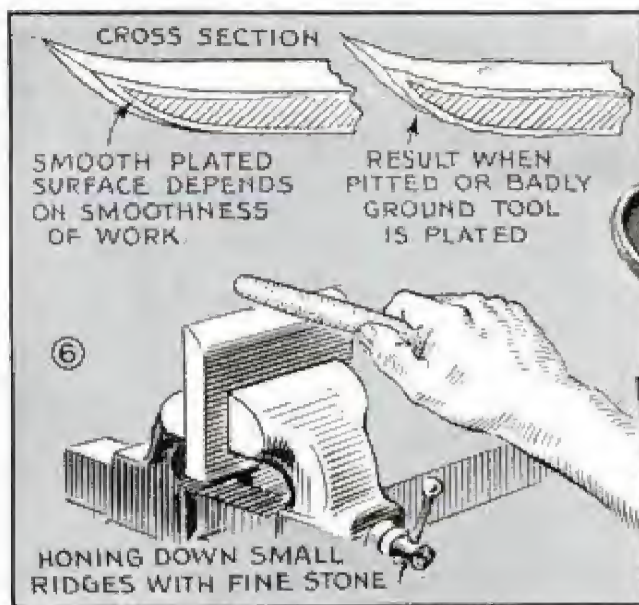
The smoothness of the plated surface varies with that of the surface underneath as shown in Fig. 6. Therefore surface irregularities of the work are removed before plating it. Preliminary smoothing of a rough surface is accomplished by grinding with suitable stones. This is followed by a thorough buffing, Fig. 8, using a cotton buff charged with fine silicon carbide in lard, then tripoli. For final polish a high-speed flannel buff charged with rottenstone is used. Holes, such as those in a pair of pliers or scissors, resist plating because the hydrogen generated is sufficient to drive chromium away from surrounding surfaces. These holes are plugged with wax, plastic clay or cork as in Fig. 7.

Successful chromium plating depends on keeping the sulphate percentage of the solution within bonds, keeping the temperature of the solution constant at 95° F., and applying the proper amount of current, which is 75 amps. per square foot of surface being plated. An effective plating solution is given at the left of Fig. 1. The

RUST-REMOVING FORMULA
HYDROCHLORIC ACID, 1 OZ.
WATER, 10 OZ. (HEAT TO 120°)

the solution gasses violently and the fumes produced should not be inhaled as they are injurious to the nose and throat lining. To avoid this, a fan is placed between the operator and the tank to blow the fumes away through an open window. Fan-equipped exhaust hoods are also used. An additional precaution to prevent injury from breathing the fumes is to rub vaseline inside the nose, especially on lengthy plating jobs. Rubber gloves are worn when handling the work or any other time when there is a possibility of getting the plating or rust-removing solution on the hands. However, if the worker accidentally gets some on his hands, immediate rinsing in running water will prevent any harm.

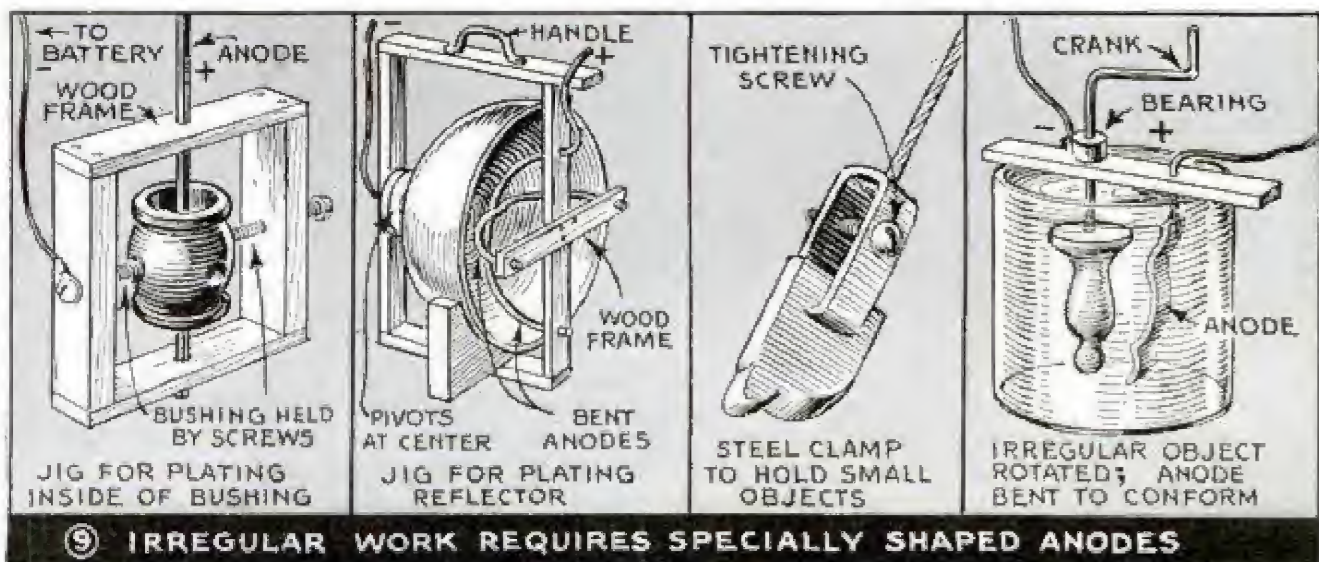
Rust on the work to be plated should be removed, although scrupulous cleaning



chemicals must be proportioned carefully as indicated in Fig. 3. Commercial chromic acid has a light amount of sulphate in it and usually requires the addition of a small amount of sulphuric acid with a medicine dropper. When the correct amount of sulphate is present, a bright deposit of chromium will be produced at a temperature of 95°, provided the correct amperage is applied. To test, add sulphuric acid drop by drop while plating a sample piece. The table given in Fig. 4 shows exact current requirements for various areas from 1 to 100 sq. in. Current is supplied by a 6-volt, heavy-duty storage battery. The negative side is connected to the work and the positive side runs through the ammeter to the anode, as shown in Figs. 1 and 2. Use heavy rubber-covered wire or flexible cable of large enough size so that it will not heat excessively when a large current is passed. If any one or more of the three factors controlling the success of the work are at fault, the plate deposited will be



Tools to be plated must be free from rust, pits and scratches if a smooth coating of chromium is expected. If necessary, grind down the tool and polish to a mirror-like surface



9 IRREGULAR WORK REQUIRES SPECIALLY SHAPED ANODES



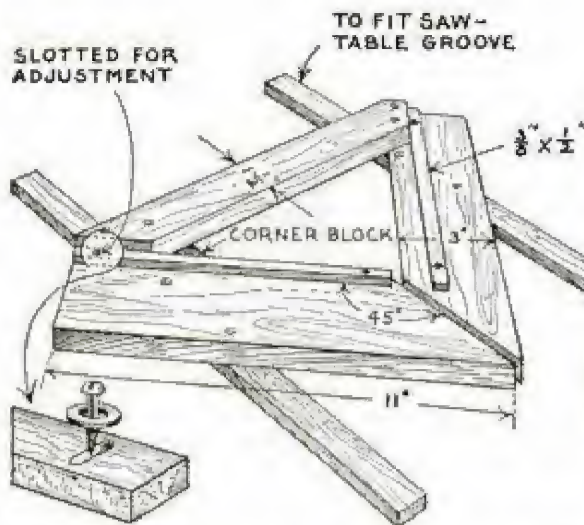
milky, flaky or muddy. The first 5 seconds determines the type of deposit, but it usually takes about 20 minutes to build it up to satisfactory thickness. If the deposit at first is not right, it can be removed from the work by immersing in the warm rust-removing solution.

Odd-shaped pieces of work require specially shaped anodes because the chromium is deposited first and most on parts of the work closest to the anode, and may skip those farthest away. A number of methods for spacing the surface of the anode equidistantly from the surface of the work, are given in Fig. 9. Uniformly curved surfaces such as reflectors are rotated a few degrees every minute to obtain uniform plating. In lining a bronze or steel bearing, the anode is a lead rod located in the exact center of the bearing. The entire jig is dipped into the solution and is kept in constant motion while plating. The current flow is determined by the area of lead immersed, and experiments are first made in order to determine the proper diameter needed for giving the correct amperage for the area of work. When large surfaces are to be plated, the heavy current required makes it necessary to have good contacts between the work and wire from the battery. Wherever possible the wire is soldered to the work; otherwise a strong spring-type clip is used, which is shifted in position during plating to avoid unplated spots. The area of the clip should be added to that of the work to get correct



figure for current. Statuettes and ornaments are best plated in a dilute plating solution. Start them at lower current than the maximum given in the table and increase the current gradually to maximum as the plating progresses. Objects having irregular surfaces not sufficiently pronounced to require specially shaped anodes should be kept moving constantly in the plating bath to assure an even coating of chromium all around. In order to plate metals other than steel, copper or nickel, they must be copper or nickel plated before applying chromium. For cutting and abrasion resistance on tools, a .005-in. plate is sufficient. When plating tools, allowance is made for grinding down the surface to a keen edge, and for this reason an extra thick deposit is made. When work has been given a plate of sufficient thickness, it is washed in running water and is buried in maple sawdust, which dries it and prevents the formation of water spots. See Fig. 10. After using chromium-plating solution, its sulphate content increases and the quality of the work decreases correspondingly, but the addition of barium carbonate to the solution, as shown in Fig. 11, neutralizes the sulphate. This is stirred in and allowed to settle, after which the clear liquid is poured off and filtered. More chromic and a slight amount of sulphuric acid are added to restore the solution to original strength.

Cutting Accurate Miters on a Circular Saw



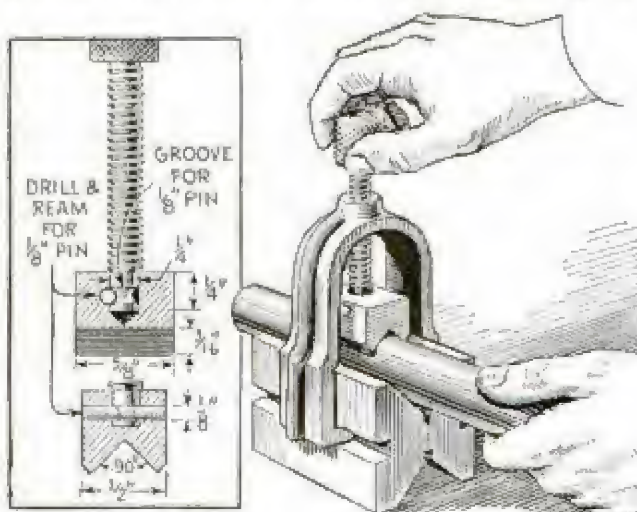
Work mitered on a circular saw with the aid of this jig will fit accurately when joined because the two cuts are made at the same time. In this way, there is no possibility of slight variation in the angle at which the work is fed into the saw as sometimes happens when the cuts are made separately. Wood strips slide in the miter-gauge grooves of the saw table to keep the jig in alignment. The jig can be built to accommodate any width of material by varying the width of the diagonal pieces and the spacing of the adjustable strips.—Walter E. Burton, Akron, Ohio.

Double V-Block Clamp Grips Work without Marring It

In my work as a machinist, I often have to use screw-type V-blocks and find that the screws sometimes mar the work badly. To avoid this, I fitted small V-blocks to the ends of the screws as shown. The small blocks were drilled in the centers to take the screws, which were turned down at

the ends to fit the holes. The blocks were held in place by small pins, which passed through the blocks and fitted in grooves turned near the screw ends. This arrangement allows the blocks to turn freely.

—L. Malecki, Chicago.



Vacuum Cup Holds Eraser on Typewriter

Attach your typewriter eraser to a small vacuum cup as indicated, and you can stick it on the typewriter so that it will always be at hand when you want it.

A vacuum cup with a small bolt molded in it can be obtained at a dime store.



Adjustable Rail for a Sawhorse Has Many Uses



An extra rail on a sawhorse that can be adjusted to various heights is handy around the shop. It can be used to support a plywood panel to add additional working space on a bench, or to support extra long work on a bench, or on your circular saw.

Fuller Ball Used as Handle on Threading-Tool Gauge

Small threading-tool gauges are easy to use if you fit them with this simple handle. It is nothing more than a fuller ball slit part way through to slip over the end of the gauge as indicated. Besides providing



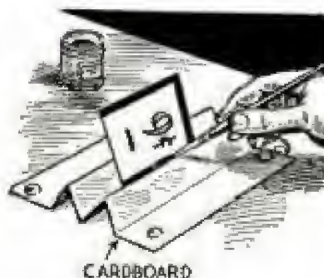
a good grip for the fingers, the handle makes the tool easier to pick up, and it can be slipped off in a jiffy when the large end of the tool has to be used.

Position of Stovepipe Damper Located Accurately

To assure accurate location of stovepipe dampers, one Wisconsin hardware dealer employs an arc of sheet metal, which fits snugly over the standard 6-in. stovepipe. Notches in the ends of the arc are spaced exactly one half the circumference of the pipe so that the metal may be punched at the indicated points to install the damper.



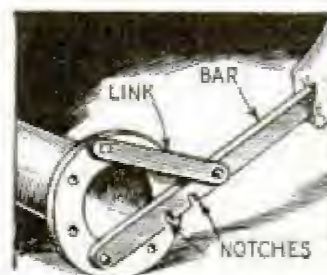
Even Borders on Price Tickets Assured by Using This Guide



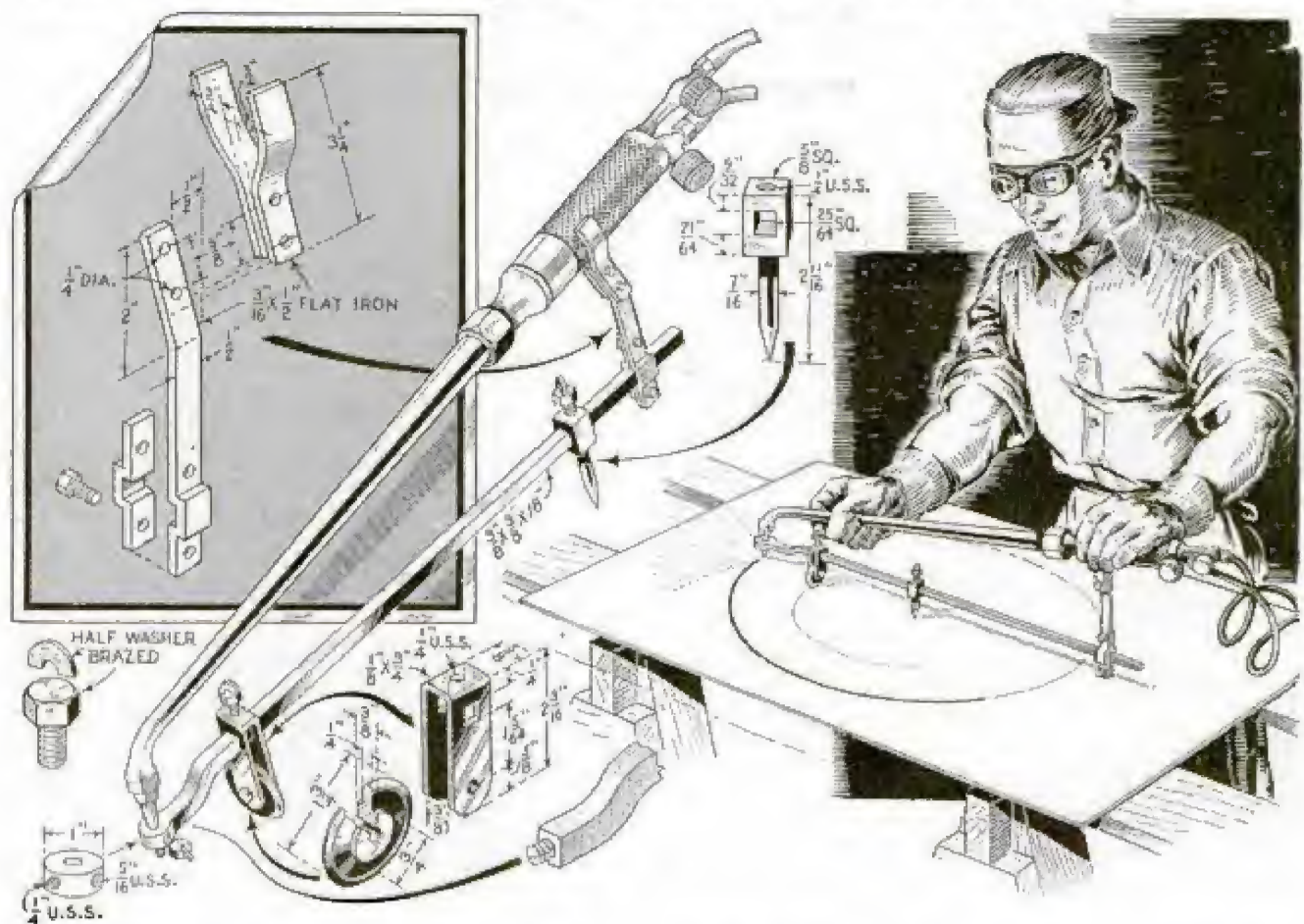
Having a large number of price tickets to prepare for a special sale, and desiring to paint a neat border on each one, a showcard artist facilitated the work by means of a trough made from a folded strip of cardboard. This was attached to his desk with thumbtacks, and each ticket was inserted at the angle indicated so that the trough would serve as a gauge for the brush.

Large Pipe Flanges Turned Easily with This Spanner Wrench

For the factory-maintenance crew, this spanner wrench is better for turning large pipe flanges than the usual method of putting two bolts through the holes and using a bar. The wrench consists of a steel notched bar and a separate link that is adjusted to various sizes.



Gas-Torch 'Compass' to Cut Out Metal Disks



Owners of small shops who do not have equipment for cutting circles or disks in steel plates, will find this inexpensive attachment for a gas-cutting torch just the thing for the job. When the work is done free hand, it is almost impossible to avoid ragged edges that require considerable machining to finish them. With the attachment anyone can cut circles having smooth edges and ranging in size from a few inches to nearly 3 ft. in diameter. If the small

wheel near the torch tip interferes with moving the adjustable pivot close enough toward the end of the torch for a very small radius, it is a simple matter to remove the wheel and put the pivot in its place. When a number of duplicate disks are to be cut from stock up to $\frac{1}{2}$ in. in thickness, several pieces of the metal can be stacked and cut in one operation, and thus save considerable time.

—A. L. Havens, Rutland, Vt.

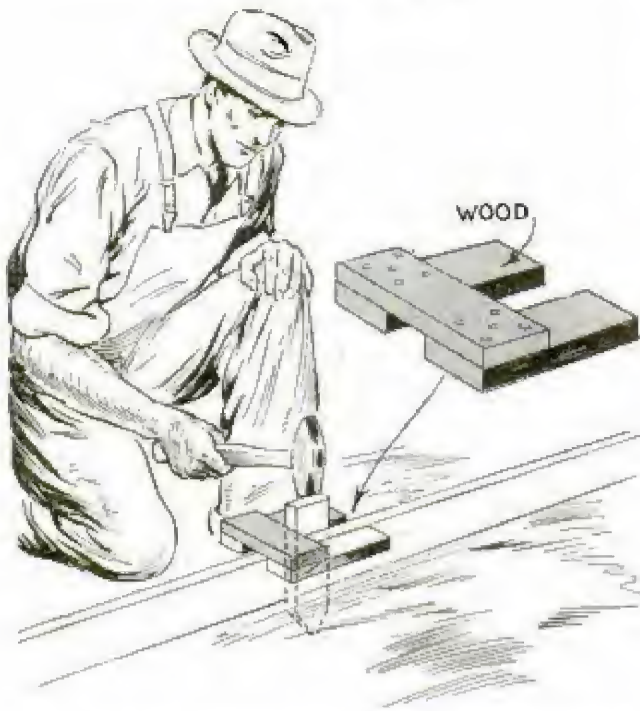
Tooth from Hay Rake Serves as Shock Absorber in Tether

To provide a spring in a tether that would tend to absorb shock on an animal's neck when it stretched the tether suddenly, and at the same time allow it to rotate on the stake without winding up, a farmer used a hay-rake tooth. This was annealed at the pointed end and an eye was formed to attach the tether. The tether stake was driven into the ground through the coiled portion of the tooth near the other end.

❶ A tool box is more efficient if the partitions are cut a few inches lower than the top of the box to leave room for carrying wide, flat tools on the trays.



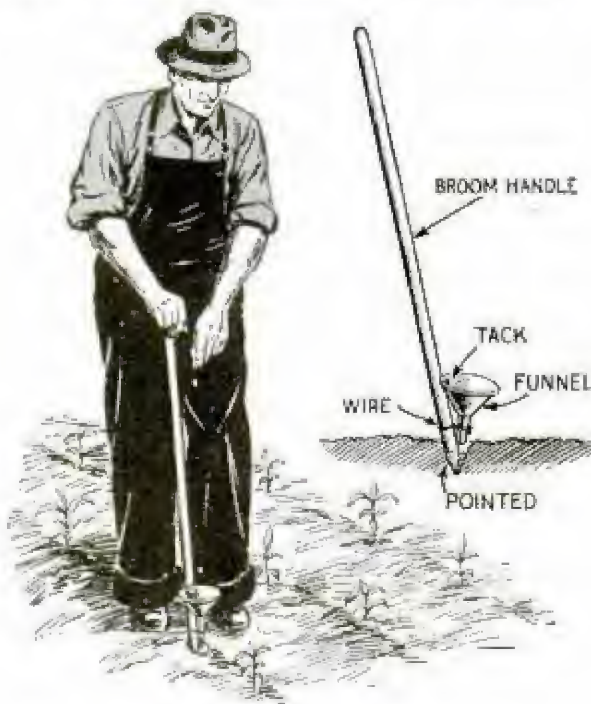
Concrete-Form Stakes Driven with Aid of Jig



To aid in driving anchor stakes vertically, and firmly against the form boards for concrete walks, one contractor employs this simple jig. It consists of three wood blocks nailed together as indicated.

Simple Tool Replants Corn and Beans

Going over a large corn or bean field, to replant the hills that failed to grow, is a tiresome task especially if each hill must be dug with a hoe to receive the new seeds. If a funnel is attached to the end of a



sharpened broomstick, this tool may be employed to do the work. The point of the stick is inserted into the soil at a slight angle, then pushed forward to make an opening of the desired depth directly below the funnel spout. The required number of seeds are then dropped into the funnel, the tool removed, and the seeds covered by pressing the soil down with the foot.

'Fishpole' Tether for Mother Hen Cannot Tangle

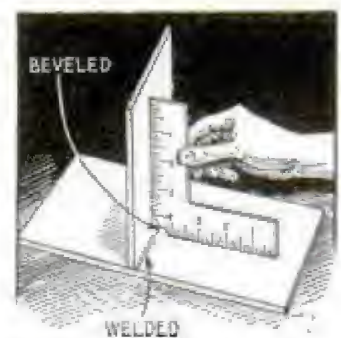
When a mother hen must be tethered on the lawn or in the barnyard to prevent her from wandering away, the usual annoyance of a tangled tether line may be avoided



ed by using a fishpole for the tether stake. Any pole will do just so it is longer than the line. The hen may walk comfortably about in the restricted circle and with no danger of the line being caught.

Corner of Square Beveled to Check Angle of Welded Work

The difficulty of checking a joint that has been welded at a 90° angle can be overcome by using a small square that has been beveled at the corner as indicated. The bevel allows the square to bridge the weld metal so that it butts accurately against the two sides of the work.



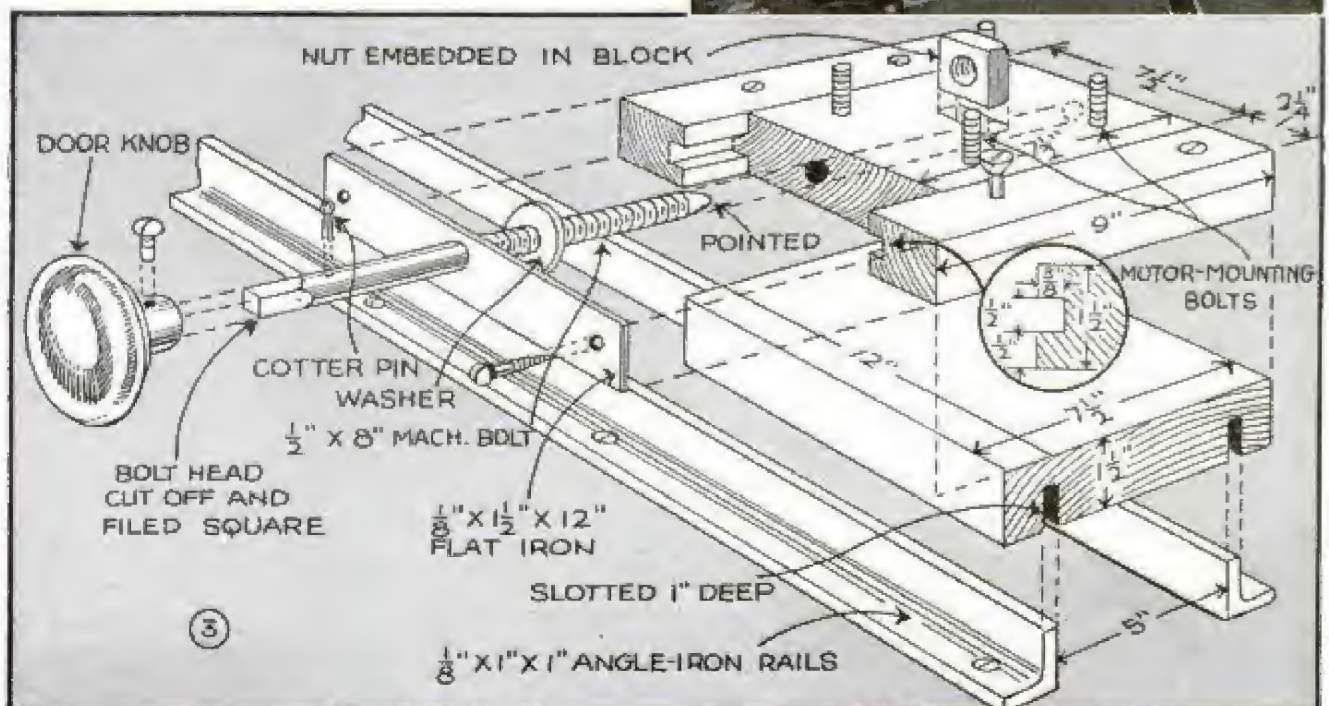
—E. D. Biggerstaff, Jr., Macon, Ga.

Sliding MOTOR MOUNT

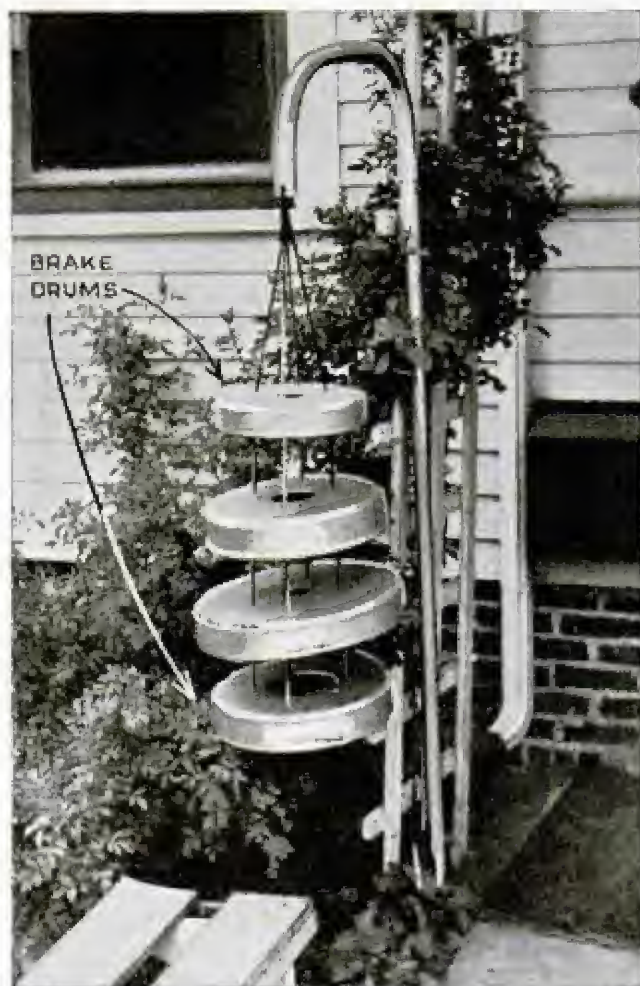
Serves bench-top machines

By H. O. BUMANN

MOVABLE longitudinally on two angle-iron rails running down the center of your bench top so that it can be slid into position quickly, to operate any one of several small power machines mounted on each side as in Fig. 1, this quick-change motor "carriage" is adjustable laterally as well, for tensioning the belt of each machine as shown in Fig. 2. The lower block of the "carriage" is slotted to slide freely on 1 by 1-in. rails spaced about 5 in. apart. The center piece of the upper assembly to which the motor is bolted, slides on two grooved members screwed to the lower block, and is made adjustable crosswise by means of a bolt passing through a flat-iron brace and into a nut embedded into the wood as shown in Fig. 3. Machines which may be operated either clockwise or counterclockwise, such as a jigsaw, disk sander, etc., should be mounted along the rear side of the bench so that other machines, which must run clockwise, can be driven without twisting the belt.



Brake Drums Serve as Signal Gong for Farm Home



Replacing the antiquated farm dinner bell, four old brake drums of various sizes, suspended from a pipe standard by small chains, will provide a pleasantly toned signal gong for use at the farm or suburban home. If care is taken in selecting the drums, you can assemble four of them that will produce tones closely simulating the notes of a chord. The supporting chains are threaded through bolt holes in the drums, which are coated with aluminum paint. A wood mallet is best for striking the drums, which will produce a sound that will carry a considerable distance.

Loose "Tire" Prevents Clogging of Tractor-Wheel Lugs



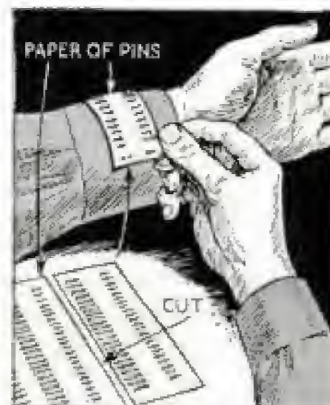
Under certain conditions, impacted soil and trash "bridges" across tractor-wheel lugs to such an extent that the machine loses

headway due to slippage. One farmer overcame this trouble by placing a loose iron band over the tire between the two rows of lugs. For tractors with small-diameter wheels an old wagon tire is just the thing. In any case, the band should be of $\frac{1}{4}$ -in. iron, and the ends should be welded to form a ring, the inside diameter of which is about $1\frac{1}{4}$ in. larger than the outside diameter of the tractor wheel.

Tailor Carries Pins on Wrist

Tailors and others who use many pins can save time and always have them at hand if the pins are carried on the wrist. A good way to do this is to cut a paper of pins in strips as indicated, and fasten one of the strips to the wrist of the garment they are wearing.

—G. E. Hendrickson, Argyle, Wis.

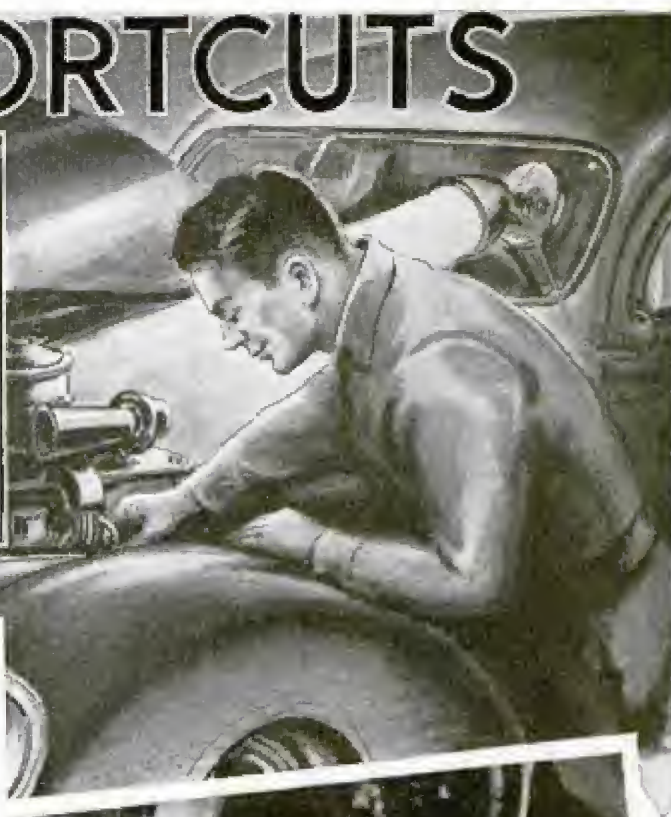
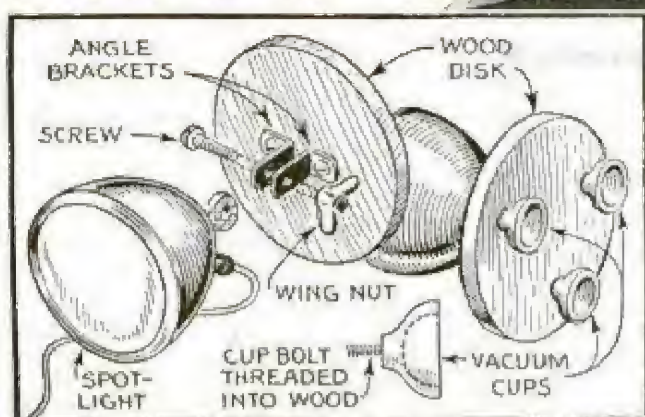


All-Metal Utility Hand Truck Can Stand Hard Use

Here's an all-metal hand truck that will come in handy for hauling heavy loads around the farm buildings. The axle is a length of pipe to which iron wheels from the scrap pile are keyed. A second length of pipe welded to the axle forms the handle. The box or rack is made of angle iron riveted together, the bottom of the rack being pieces of flat iron riveted in place.



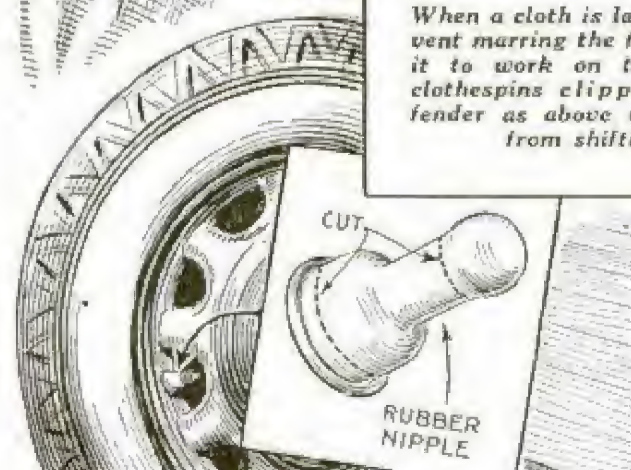
AUTO SHORTCUTS



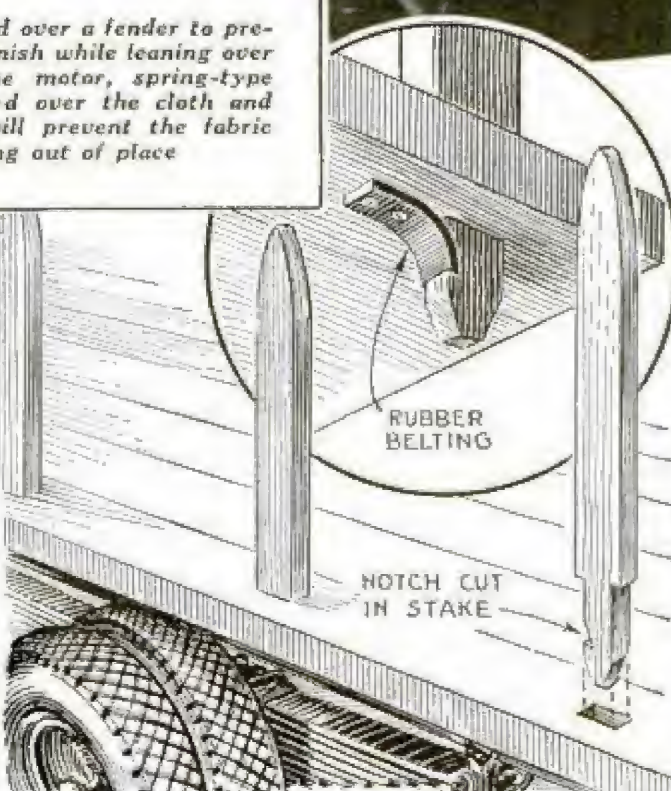
Plenty of light directed right where you want it when working on a car is possible with the portable spotlight above, which can be stuck on the windshield, windows or any part of the body. When a number of small cracks started to radiate from a large one in the corner of a safety-glass windshield, the cracking was confined to the corner by scoring a line in the glass as at right



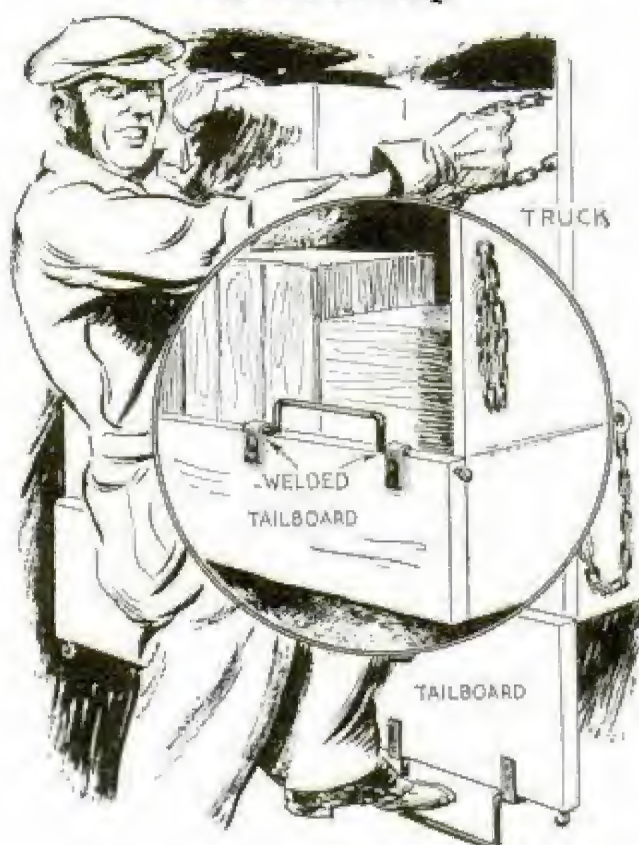
When a cloth is laid over a fender to prevent marring the finish while leaning over it to work on the motor, spring-type clothespins clipped over the cloth and fender as above will prevent the fabric from shifting out of place



Gravel and water can be kept from working into a tire around a rubber valve stem by cutting a nursing-bottle nipple as above and slipping it over the stem. To prevent the body stakes of his truck from jumping out, and yet have them easy to remove, one driver notched the lower ends as at the right and then tacked strips of heavy rubber belting on the underside of the truck floor to engage the notches when the stakes were inserted in their sockets



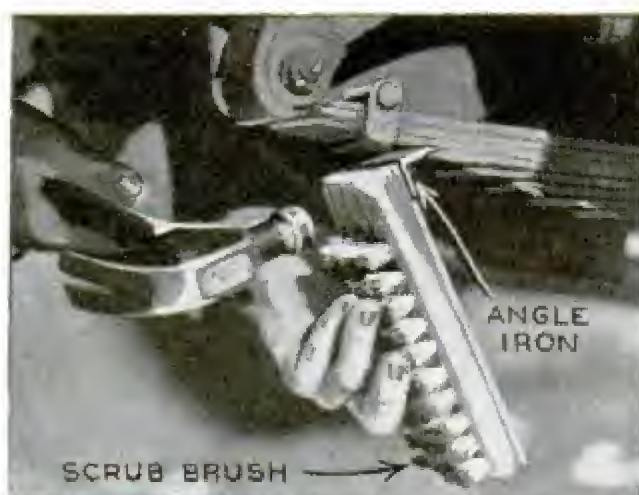
Handle on Tailboard of Truck Serves as Step



One truck driver who had to climb into the rear end of the truck many times when unloading, put a handle on the tailboard that helped in raising and lowering it. Also, when the board was in the down position, the handle served as a step.

Combined Brush and Leaf Wedge to Lubricate Car Springs

You can clean and spread your car springs for lubricating them with this homemade device. Simply snip off a couple rows of bristles from a scrub brush, and screw on a 1-in. angle iron, sharpened along the projecting edge. Hammer lightly

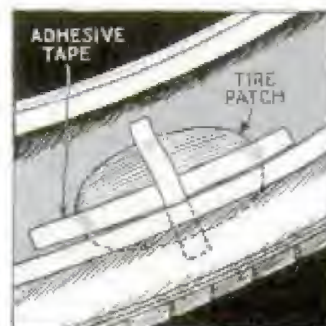


against the brush, and even the tightest spring leaf will spread sufficiently for the insertion of a lubricant.

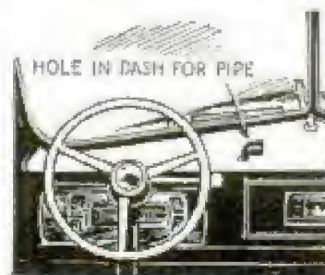
—Ormal I. Sprungman, Minneapolis, Minn.

Adhesive Tape Anchors Boot in Auto Casing

When you are obliged to place a temporary boot in an auto casing, especially in making repairs on the road where no cementing or vulcanizing facilities are at hand, you can anchor the patch with a couple of strips of tape. Bits of the tape will also serve to keep moisture out of a nail puncture until the casing can be repaired properly in a garage.



Hole in Car Instrument Panel Holds Your Pipe

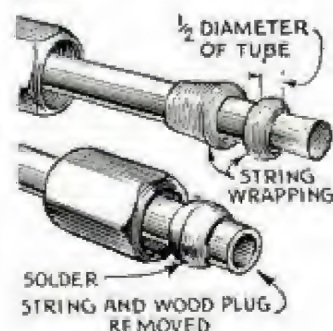


As there is no place on a car where a driver can lay his pipe temporarily, one motorist drilled a hole through the upper part of the instrument panel. This provided a safe place for inserting the stem of the pipe within easy reach of the steering wheel.

—Everett Hanson, Argyle, Wis.

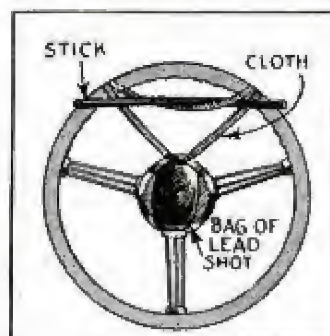
Emergency Repair for Tubing

When repairing copper tubing using compression fittings and none of the brass sleeves used on this type of fittings are available, the following method will help. Polish the end of the tubing with steel wool and plug it with a small wooden plug, allowing it to project enough so that it may be removed after repair is complete. Place the nut over end of tube and wrap the end



with string. Apply soldering flux to the space between the wrappings, and dip in molten solder. A small ring of solder will adhere to the tube, taking the place of the brass sleeve necessary in compression fittings. After dressing off any irregularities with a file, the tube may be installed as usual.—R. J. Higman, Seattle, Wash.

Weight Sounds Horn for Testing

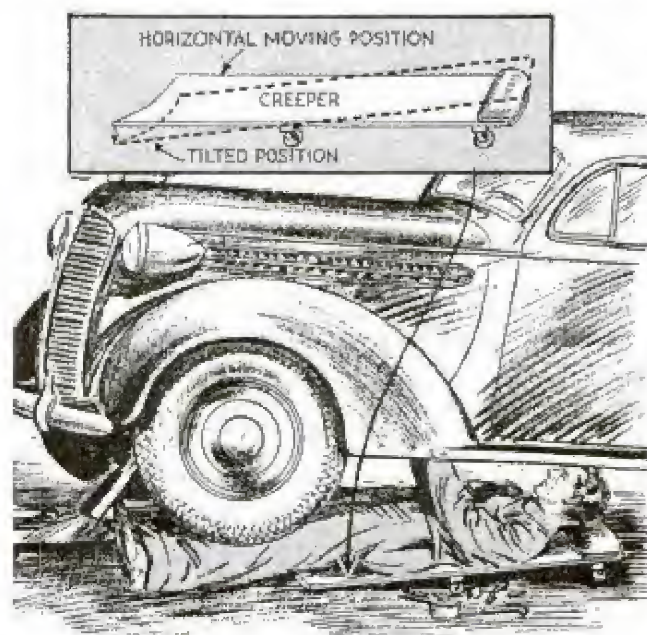


A cloth bag of shot is handy to depress the horn button while testing the circuit. This makes it unnecessary to have an assistant sound the horn, and enables the mechan-

ic to make the test without waiting for someone to be free to help him. A strip of cloth sewed to the bag permits it to be fastened to the steering wheel with a stick as indicated in the drawing.

Moving Casters Toward Center Improves Creeper

One mechanic took the casters from one end of his creeper and placed them in the center as shown. To move about, he allows his weight to rest on the fore part of the



creeper, and while working he rests his weight at the other end. In this way the creeper does not move about while he is working under a car.

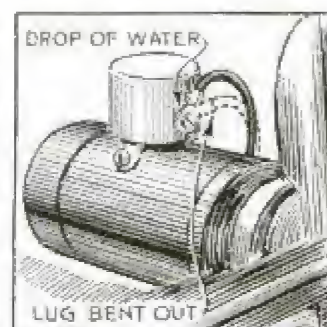
Pressure Stick Holds Inner Tube in Tub of Water



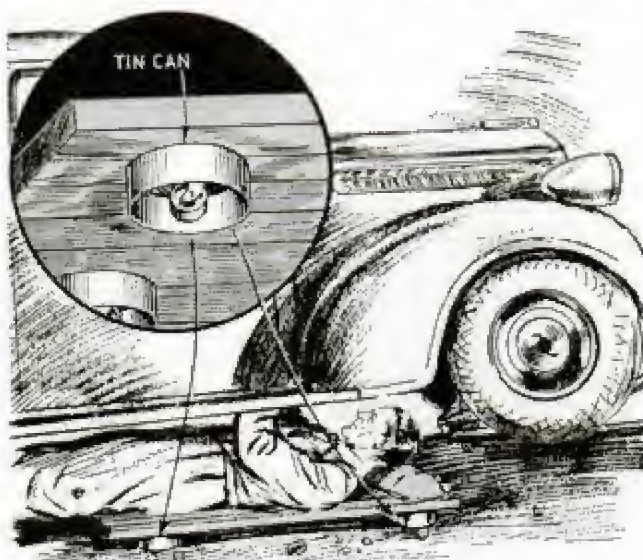
Seeking a handy method of holding inner tubes under water for testing them, a garage mechanic slipped two short pieces of hose over the ends of a broomstick. The over-all length of the stick and hose combined was a little greater than the diameter of the water tub. In use, a tube to be tested was submerged in the tub and the stick pushed down on it, thus binding the projecting ends of the hose against the sides of the tub to hold the tube in place.

Water on Generator Cutout Short-Circuits Battery

A mysterious short circuit in the electrical circuit of a truck was found to be caused by a drop of water that collected between the generator cutout and the small lug to which the wire was connected. The "short" appeared only during wet weather, and would run down the battery overnight. To prevent the trouble, the lug was bent outward to increase the space between it and the cutout.—H. B. Linn, Coronado, Calif.



'Cowcatchers' on Garage Creeper Allow Free Action of Casters



To keep bolts, nuts and other small obstacles from hindering the operation of the casters on his creeper, one mechanic put tin cans over them. These were cut to a height to just clear the floor when nailed in place, and served to brush all small articles out of the way of the casters.

Clogged Line to Gasoline Gauge Cleaned with Wire

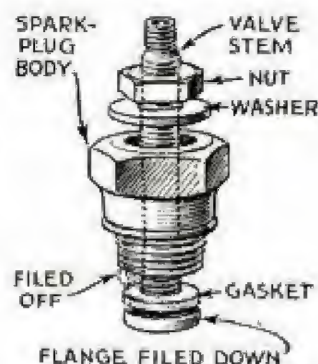
When a hydrostatic gasoline gauge does not register, I disconnect the line at the gauge end and clean it with a piece of piano wire about 8 in. in length. One end

of this is ground flat like a chisel, and the other end is put in a small electric drill. With this tool I drill out the corrosion in the line, which is usually within a few inches of the gauge end.

—T. E. Bordner, Willard, Ohio.

Locating Compression Leaks

Here is a simple device by which you can locate compression leaks. It consists of the base of an old spark plug and a tire valve assembled as shown. In use, the plug is removed from the cylinder suspected of losing compression and the device is screwed into the spark-plug hole. Then the motor is cranked to bring the piston to the top dead-center firing position, after which compressed air is admitted through the device at a pressure of 100 to 135 lbs. Any air leaking past the piston and rings will blow out of the crankcase filler tube. An intake valve that is not seating properly will allow air to escape through the carburetor inlet, while air blowing out of the muffler indicates a bad exhaust valve.



the device at a pressure of 100 to 135 lbs. Any air leaking past the piston and rings will blow out of the crankcase filler tube. An intake valve that is not seating properly will allow air to escape through the carburetor inlet, while air blowing out of the muffler indicates a bad exhaust valve.

—Edward N. Avery, Dunmore, Pa.



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Dress Rehearsals for Danger Aloft

(Continued from page 219)

cided. The pilot's flight plan, made out before the flight, was checked to learn where he expected to be by now. The earlier position reports received from the plane were checked against the flight plan to confirm it. Changes in the wind since the last position report were used to help determine exactly where the plane had to be.

Fuel gallonage remaining in the plane was determined by computing consumption and time, to learn the plane's cruising radius that remained. The picture was completed by studying the map of the

to the automatic pilot so that the plane will steer itself along the airway as well as fly itself without help.

One of the latest projects in instrument flying is the suggestion that a television receiver coupled to a special photoelectric cell can be made to penetrate clouds and fog. The result would be that a pilot, flying blind, could watch the ground below and in front of him by glancing at the television screen. Progress has already been made in developing a photoelectric cell that is sensitive to infrared rays, which pass through fog easily.

The more efficiently an airplane is flown the safer it is. Fuel, passengers and cargo must be balanced scientifically to preserve the plane's normal center of gravity. Throttle settings and revolutions per minute must be regulated to the most efficient engine performance, considering load and altitude. Any of half a dozen factors, wrongly estimated, is apt to increase fuel consumption and thus reduce the time an airplane can remain aloft. In the past pilots and dispatchers have spent hours over calculations, but now mechanical brains do this thinking for them.

One instrument, called the Librascope balance computer, is a sort of electrical slide rule that shows the total weight of the airplane's load and its center of gravity after the dials marked "cargo," "passengers" and "fuel" have been turned to the proper settings. If the center of balance is wrong, fuel and cargo dials may be re-set for different loading arrangements until the right balance is achieved.

A power computer that works on the same principle tells the horsepower, fuel consumption and effective pressures for a given set of operating conditions. A flight computer solves fourteen problems concerning optimum engine settings after its dials are adjusted to the weight of the airplane, altitude, wind velocity, and other flight conditions. The inventor of these instruments, Lewis W. Imm, of Glendale, Calif., is perfecting two other computers, one to forecast local weather after meteorological reports are fed into it; the other will automatically predict speed, rate of climb, and other characteristics of a proposed design of airplane when the machine is supplied with engineering data.



Air line weather room where reports are gathered and airway weather for next few hours is forecast

present weather. That showed the flight superintendent the route that would take the plane to clear weather, and this information was prepared so that it could be broadcast to the plane.

The campaign for perfect safety in the air has resulted in many improvements to airplane instruments. The latest to appear on the instrument board is the radio height indicator, a device that shows the plane's true altitude above the ground instead of measuring its height above sea level. A different adaptation of the same principle may be worked out to indicate the presence of mountains ahead or to one side of the plane.

Radio is the pilot's best friend and today it is being put to more and more uses. The radio direction finder has been trained to keep its needle pointed toward the ground station to which it is tuned, no matter in what direction the airplane is turned. The next step is to couple the direction finder, tuned to the airway radio-beam frequency,

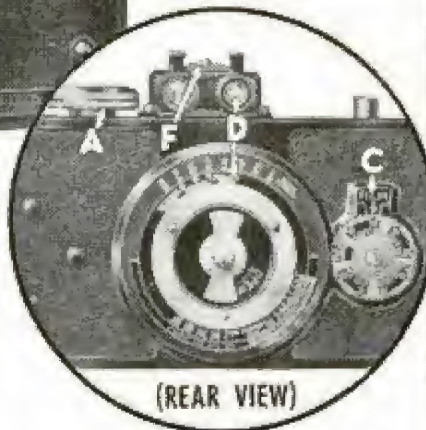


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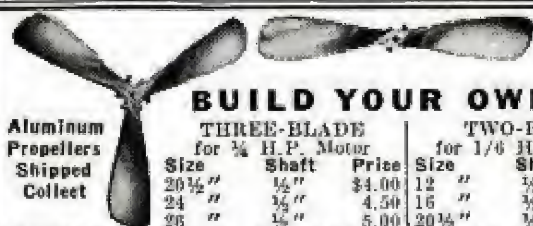


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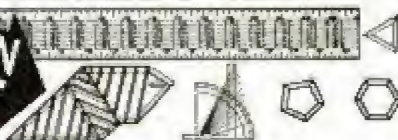
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Trappers of Lightning

(Continued from page 255)

records have been obtained from the lightning thus trapped."

The lightning hunters staked out one trap on a fifty-foot steel mast on top of the 535-foot Cathedral of Learning in Pittsburgh, then patiently awaited their prey. They didn't wait long. In mid-July a terrific bolt of lightning scored a direct hit and was "caught" in the trap. Lasting approximately one-sixtieth of a second and with a maximum crest of 21,000 amperes, the bolt was conducted through a new auto-valve lightning arrester no larger than a quart fruit jar. At its peak, the flow of power was equivalent to the current drawn by some 40,000 light bulbs.

The lightning trappers were elated. Not only had they discovered a method of inspecting natural lightning at close quarters but they had also developed an arrester which would permit them to do so safely and which could safeguard power lines and other objects exposed to lightning. Throughout the country other lightning traps added to scientific knowledge.

Investigators have discovered that the average natural lightning stroke consists of a core about the size of a man's finger which, upon the completion of the initial discharge to the ground from the cloud, explodes in a column of sponge-like fire about four inches in diameter. This explosion causes thunder. They learned that lightning consists of two essentially distinct parts. First, a leader stroke traveling under tremendous voltages, often as high as 20,000,000. This leader stroke breaks down the air insulation between cloud and earth and establishes a lightning path.

When the leader stroke hits the ground it causes a heavy surge of high current to flash through the path, thus producing the lightning channel. The leader travels about 1/1,000 as fast as light, but the current discharge races along the path at about one-fifth the speed of light or more than 37,000 miles a second. The lightning surges, which are the electric charges introduced into a power line by a stroke, are equivalent to electric bullets which rip through anything in their path.

The scientists now conclude that the first rush of heavy current through the channel of a natural lightning stroke might be

compared with the heavy stream of water that spurts from a sponge as it is squeezed quickly. But just as a continued squeezing of the sponge produces a small but steadier stream of water, so a steady seepage of charges from the cloud into the main lightning channel sets up a lower current but longer-duration discharge which carries fiery destruction.

In a laboratory at the Westinghouse transformer works in Sharon, Pa., the lightning investigators built a three-story stairway of thirty-six banks of condensers, each charged with 100,000 volts of direct current with a combined output of 3,600,000 volts, comparable to the high applied voltage rise of a lightning stroke after it has struck a power line or a tree.

Another shorter stairway was built to carry eight banks of eight condensers, each condenser representing so many cubic feet of a thunder cloud, and acting together to produce 150,000 amperes of current for a period as great as 200 millionths of a second.

Key to this apparatus is a tiny microsecond switch invented by Mr. Bellaschi. It can act in a millionth of a second and it stands just so much electrical pressure or voltage; when the pressure reaches a critical point, the plug melts, setting free the high current. It synchronizes the two stairways of power and releases their combined output of pressure and current in proper sequence as a genuine reproduction of real lightning, duplicating every one of its physical effects from the crash of thunder to the shattering of poles and steel-covered electrical apparatus.

Today it is no longer necessary to install a lightning arrester or distribution transformer, for example, and "hope" it will stand up if struck by lightning. Instead, as each piece of equipment is completed, Westinghouse engineers take it into the laboratory and bombard it with a bolt of lightning so like nature's that if it emerges unscathed, the possibilities are ninety-nine to one that it will protect life and property when exposed to actual thunderstorms.

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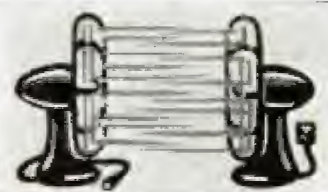
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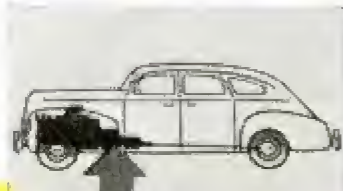
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Seeking Power for Space Rockets

(Continued from page 213)

climbing speed of 700 miles per hour, far greater than the fastest airplane. Since that time, Goddard has continued his experiments in perfecting rocket design. Recently he incorporated a gyroscope to stabilize his rockets during flight.

However, the old problem of a sufficiently powerful fuel and a sufficiently durable firing chamber still remained. Certain experiments seem to favor the use of powder explosives, but in general, liquid fuels seem to offer the best prospects. A combination of liquid oxygen and gasoline has proved very efficient.

Rockets powered by such fuels have been used by the American and German rocket societies. A British society has made speculative plans for space travel should the day ever arrive when fuel and construction problems are licked. This society has designed space suits, and has even made tentative arrangements to secure human beings who would be willing to take the terrific gamble should the conquest of space ever be technically possible.

These problems of fuel and combustion chamber the California Tech. scientists have set out to study—and they have made such advancement that they talk of a sounding rocket which might reach a height of half a million feet.

The first problem faced was to design a highly accurate testing machine. Such a device must be able to register thrust, temperature, pressure of gases, amount of fuel used, and the efficiency of the combustion.

For experimental purposes gaseous combustibles are used instead of liquid. The propellant now being experimented with is a mixture of ethylene and oxygen. These gases are kept under pressures of 1,200 and 2,000 pounds to the square inch. Operators control the flow of gas by means of valves. The gauges which record the performance of the rocket motor are photographed to give a permanent record.

The rocket motor is a single steel cylinder about eighteen inches long and six in diameter. It is lined with carbon to guard against the terrific heat when the motor is operated. A temperature of 5,000 degrees Fahrenheit is sometimes reached—almost half that of the sun's corona.

Rocket motor, tanks of ethylene and

oxygen, and connecting tubes are mounted on a torsion balance so delicate that it will register forces of only one-tenth of an ounce. When the motor is fired, motor, lines, and braces move as a single unit. The thrust is then registered by a dial on the control panel.

Because of the terrifically explosive character of all fuels used, the control panel and operator are protected from the firing chamber by sandbags. Once a nozzle blew out during a test, and the resulting roar was heard for blocks.

Nozzles for the rocket motor are made from such substances as pure carbon, stainless steel, and copper alloys. Experiments have shown that few substances will stand the extreme heat and pressure of the exhaust gases. Velocities of 6,000 feet per second, or better than 3,600 miles per hour, have been recorded. Often after one minute in the firing chamber, a nozzle, which a moment before was a beautifully machined piece of metal, will be charred, distorted, and blacked, looking as if it had been subjected to the eternal fires.

Rocket scientists have calculated that a velocity of seven miles per second, or approximately 25,000 miles per hour, would be necessary for a rocket to escape the earth's gravity. They further believe that 6,000 tons of fuel would be necessary to carry ten tons of pay load. The California men do not speculate on space travel. However, they do say that their experiments indicate that with a "step" rocket (one having three motors, two of which would be released during flight), a velocity of 11,000 feet per second might be reached. This would carry the rocket to a height of 500,000 feet, five times the record height for a sounding balloon. Physical information gathered by such a rocket would be of incalculable value.

Meanwhile, the motor behind the sandbags hisses and thrusts and the needles on the dials continue to write their record of vital facts. And another significant step is being taken in man's struggle to conquer space.

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Miracle Men of the Corn Belt

(Continued from page 229)

snapped them off. Thus, the tassels remaining could shed their pollen on the silks of the ears in the other two rows. The summer proved a scorcher. The sun began to fire the stalks in the regular fields and not long afterwards the plants in the test patch began to droop. Pfister would not baby them; he was striving to develop a breed of corn that could "take it," no matter what the weather.

His regular corn at harvest time was little more than withered husks but the hybrid stalks were straight as fence posts with ears filled with deep, even rows of yellow kernels. He had made a good start, but still wasn't satisfied. He decided to secure some of the government's pure inbreds to cross with his own. That meant more years of testing—and sacrifice. He wasn't a research worker of a richly endowed foundation; he was just a seed grower of limited means, staking everything on an idea. He was hard pressed for money and his farm was beginning to look run-over-at-the-heels. He knew he was taking a long chance but he didn't weaken on his experimental program. For a time, success was elusive. Then one spring he produced the finest crop of corn ever seen in his county. His troubles were at an end and at present he directs a million-dollar hybrid seed organization.

Several kinds of hybrids are possible, depending on the number of inbred lines involved. The simplest is the crossing of two inbred lines, but most commercial hybrids are double crosses, produced by crossing two single crosses. Commercial seed production is effected by planting alternate blocks of two parents or inbreds in a field isolated from other corn and removing tassels from all of one kind by special machinery before the pollen has been shed. The seed picked from these detasseled rows is hybrid seed.

James R. Holbert, who has bred and produced more commercial hybrid strains than any other man, says nature doesn't like to be regimented, and without constant attention, undesirable variations and mutations, as well as the occasional out-cross, which are more or less "freaks," can soon multiply to quantities that greatly reduce their value for hybrid combinations. The foundation seed lines are hand-

pollinated and selected each year in order to maintain their purity.

To improve the inbred strains, corn scientists have gone to Mexico and South America for new breeding materials. Although these foreign corns do not measure up to ours they do have greater vigor and disease resistance. Transferring of desirable qualities from one inbred line to another was a problem until it was found this could be done by taking a hybrid, back-crossing once or twice to the desired parent, then inbreeding for six to eight years.

To speed up research, the DeKalb Agricultural Association and Funk, two of the larger hybrid seed groups, carry on breeding work in Florida in the winter months as well as in the Corn Belt during the regular growing season. Likewise, Pioneer company since 1934 has had as its winter base the growing fields of Argentina.

Inasmuch as ninety per cent of our annual crop of three billion bushels of corn is used for feed on the farms where it's grown, the work being done to develop a hybrid for this use is significant. No corn has a complete protein content, so supplementary proteins such as tankage, cotton seed, or linseed meal are also fed to livestock to obtain a balanced ration. By breeding, the seed men believe they will be able to control the composition of the corn, even breed more protein or oil into it to give a higher feeding value.

The rise of hybrid corn—23,000,000 acres were planted last year—has spurred experiments in planting and cultivating methods, the most important being the drilling of twenty-inch rows, the hills only eighteen inches apart with a single kernel of corn planted four inches deep in each hill. This system, a departure from the ordinary check-row method, wherein the hills are thirty-six inches apart in each direction, was tested last year by Pfister and a farm-machinery company, and is said to permit planting more kernels per acre, and gives each stalk more room to produce perfect ears. There is no standard row cultivation, as commonly practiced. The early and frequent use of wide tools in the seed-bed preparation, Pfister explains, insures freedom from weeds and makes their control easier in later weeks.

(Continued to page 122A)

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K 2 2 2

(Continued from page 120A)

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K 3 7 4

Get into the Swim

(Continued from page 203)

arm stroke. The head is turned to the natural breathing side and as the arm on that side is recovered—brought from the rear and forward—the air is inhaled to a one-two count. Return the face to exhaling position before the arm enters the water and exhale for the counts of one-two-three-four while the arm is being pulled down and back, completing the pull as you complete the exhalation. The right arm pull, of course, began just as the air was taken in and was completed as you began to exhale.

The best way to time a six-beat kick with the arms in the crawl is to time the breathing with the kick; thus, the breath is taken in on the right as the right foot goes down, and the left goes up on the first kick, on the count of one. When the right foot comes up, completing the second kick, return your face to exhaling position. Begin exhaling as soon as the face is returned to the water. At that point the right foot is down on the completion of the third kick. Continue exhaling as you make the fourth and fifth kicks and complete the respiration on the sixth kick. This will take lots of practice, but when you become proficient in the timing you'll have mastered the six-beat American Crawl.

Ralph Flanagan, whom I began developing when he was only seven years old, has effectively employed the crawl to become one of the greatest middle-distance swimmers in history. At twenty-one years of age he held more American swimming rec-

(Continued to page 124A)

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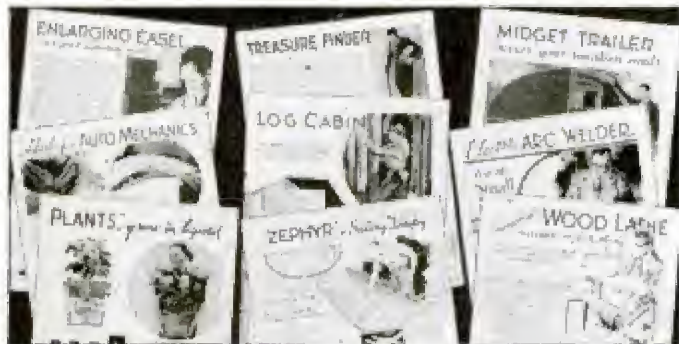


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K-374

(Continued from page 122A)

ords than any one else, in addition to a number of world records. He is regarded as one of the greatest stylists of all time.

Adolph "Sonny" Kiefer, undoubtedly the greatest backstroke swimmer ever developed, also is an example of what perfect shoulder balance can do for the water athlete. His right arm, starting a stroke, and his left arm, recovering, work like a double-bladed paddle with a windmill action, resulting in tremendous power that gives him such flashing speed. Another of Kiefer's secrets is a whiplash motion of the foot—much like the snapping of a whip—that is a big factor in his drive through the water. Whereas most swimmers depend on their arms to get speed, Kiefer depends on perfect coordination of his shoulders and a follow-through of his windmilling arms.

The latest development in aquatic sports is the butterfly breast stroke, which is still in a state of experiment. In the conventional breast stroke the hands, which must work in unison, are pulled only half way back, which cuts the power of the stroke almost in half. In the butterfly the hands are pulled downward and all the way back, very similar to the crawl except that the hands are working together. On the recovery both arms come up out of the water and forward together, again in the manner of the crawl. The kick is not much different from that employed in the conventional breast stroke, both legs working together with a froglike motion, being drawn up at either side with the knees bent and then thrust backward in a powerful kick. Immediately after the kick the arm pull begins, without pausing for a glide.

The butterfly already has been found much faster than the old breast stroke, some of its exponents being able to swim 100 yards in not much more than a minute—fast time for a crawl a few years ago.

Training for swimming should be gradual to keep the muscles from tightening up. If you try to rush the process, you'll find you're sluggish in the water—the result of uncoordinated stroking. Because swimming requires long, smooth and pliable muscles, you should avoid exercises that tend to develop hard and tense muscles.

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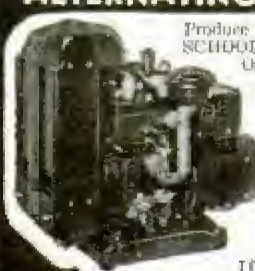
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Why Not Try the Easy Way?

(Continued from page 197)

portance of keeping the forms in balance."

Watch how a major league pitcher throws with his back as well as his arms, how the golfer gets his back into his tee shots. Rosenbauer suggests we follow their example when lifting, carrying, or pulling. The secret of putting the power of the entire body into any action is primarily a matter of poise and balance. The feet are the bases of operation from which most actions begin. The body weight is distributed between the heel and the ball of the foot. The arch is an unequal one, the heel being almost underneath the ankle tends to stay where it is put. The tendency of the long front of the arch to slip is arrested by the toes, particularly the big one. Only as the weight of the body is forward does it get the benefit of the springy arch.

"The power required to drive a golf ball 300 yards down the fairway," states the sculptor, "actually operates between the ball and that part of the earth occupied by the golfer's feet. There must be an even and direct flow of energy from the ground through the completed action. You can't get your back into action unless it's evenly geared, so to speak, to both the hands and feet. If the body is off balance, violent muscular action simply upsets the figure."

So, whether you're pushing a stalled motor car or a broom; shoveling coal or carrying a trunk, get in balance, put your back to work—and the job will be accomplished quickly and with a minimum expenditure of energy. To move a trunk properly, the trunk is tipped over on the right knee, the left hand grasps the far corner, and the trunk rolls onto the leg so that it can be lifted easily with the muscles of the legs and back. The most effective way of packing a trunk for any distance, however, is with a strip of burlap. Start in a kneeling position and pull the load over as you rise. Only one hand is necessary to hold the twisted burlap, leaving one hand free to assist in rising and guiding.

Any train usher will tell you it's harder to carry a fifty-pound traveling bag in one hand than a seventy-five-pound one in each hand. In order that he may be able to wrestle with bags for hours at a time, a red cap distributes the load equally in each

(Continued to page 126A)

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an artiste!"*



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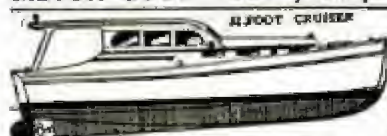
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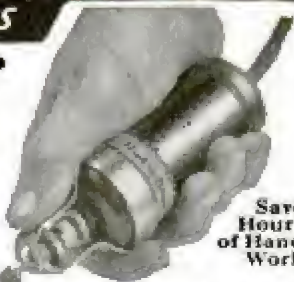
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126A



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hand. He knows enough about anatomy to realize the bones of the shoulder operate in much the same manner as a yoke by which European peasants carry their water pails so the loads tend to balance each other. And when he picks up a set of suitcases, he bends his knees, not his back.

Sitting in a chair isn't regarded as hard work, yet it exhausts many people, Rosenbauer believes, particularly when the chair of their choice isn't conducive to correct posture. By sitting easily and naturally erect we are relieving the muscles, but if we sprawl on the end of the spine or in some other grotesque position the strain is readily apparent.

Knowledge of body mechanics will help even in bicycling. A top-notch rider, whether a professional in a six-day event, or an amateur enthusiast, never throws his knees out away from the frame. He knows the knee is a hinge and should flex straight forward. Ankling is the key to correct, effortless pedaling; the ball of the foot is placed on the pedal and flexed at top and bottom of the stroke. This keeps the power constant throughout the revolution of the sprocket. Pedaling is done from the hip and ankle. Body motion only tires the rider.

There's no correct posture or stance for doing tasks that applies to everyone, concludes the Missouri sculptor, owing to the differences in physiques. The masses and leverages vary considerably in individuals and the only way a correct position can be learned is to set about discovering one's self. The person who trips easily is probably carrying his weight too far forward, he opines, and should practice walking so he can stop quickly without falling forward or jerking—a matter of carriage and correctly placing the feet. A good way to attain balance is to put your socks on in the morning while standing—and without hopping or irregular breathing.

No baseball batter ever hits the ball into the right field bleachers when his muscles are over-tense. There's a certain ease about a home run, a prize-winning shot put, or any other great sport feat. Bear this in mind when you're confronted with some heavy lifting job in your daily work. Tense muscles are slower to respond and lack power in action, so follow the advice of the sports headliner, relax and get in balance before you swing into action.

POPULAR MECHANICS

Homing Pigeons on the Night Shift

(Continued from page 251)

short moves while the birds are away from the loft, or in settling them in an entirely new location. On one occasion a loft was moved from Fort Monmouth to Cleveland, Ohio, and all birds flown to the loft within twenty-four hours after arriving.

Probably the most famous pigeon in U.S. Army history was "Cher Ami," which, according to records, carried the message that saved the Lost Battalion in the World War. When the bird reached its loft it was found that one leg was shattered and a machine-gun bullet had pierced its breast. The bird has been mounted and is now preserved in the National Museum. Another World War pigeon, captured from the German army in 1918, still lives in the Fort Monmouth lofts. Twenty-three years old, it is the last living World War bird.

Just what causes the homing pigeon to return to its loft from distances as great as 1,000 miles? Experts say that it is the homing instinct, the result of certain faculties, partly innate, partly acquired, which have been developed, modified and exploited by man for practical purposes. This is the instinct of orientation, which has been the subject of contradictory explanations. The remarkable improvements in the race since 1914, by means of intensive training, have undoubtedly proved that it cannot be explained as some special, mysterious and unchanging instinct, but as greater acuteness of certain senses and faculties. The ensemble of the bird's intellectual faculties constitutes its intelligence. The principal faculties manifested by the pigeon's return are attention, observation, memory, will, sense of direction and physical fitness.

The ear seems to play an important part in the pigeon's sense of direction. It is regarded as possible that the sensitiveness of certain parts of the inner ear enables the bird to perceive magnetic and atmospheric impressions.

A mature pigeon, if properly trained and in good health, is capable of covering distances up to 600 miles in a single day. However, weather conditions are an important factor and absolute reliability cannot be expected for distances over 200 miles. Normal military requirements for use within divisions generally range from three to twenty-five miles.

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Sea Giants on Parade

(Continued from Coloroto Section)

With his associates, Prof. Irving sought to learn why the porpoise, an air-breather, can be comfortable in the water where its need for frequent breathing is a handicap in the pursuit of food beneath the water's surface. The scientists, with the aid of the studios' staff, found that a porpoise weighing 400 pounds consumes approximately one liter of oxygen per minute while resting in the water. Oxygen is secured from air which is breathed at the rate of two or three times a minute. The porpoise, at the end of an expiration, takes in about ten liters, about two and one-half gallons of air, at each breath. By measuring the actual rate of utilization of oxygen the scientists found that oxygen stores of the mammal are virtually depleted after two minutes under water.

Suspecting an internal arrangement for sidetracking some tissues and utilizing the oxygen mainly for tissues most sensitive to its lack, Prof. Irving found that the heartbeat of the porpoise at rest in a tank is about eighty to ninety, immediately after breathing. An electrocardiograph was employed in this work. Going further, it was learned that during a dive, the porpoise's heart slows down to about thirty beats a minute, thus showing that less blood is circulating and that probably most of it is being directed to the brain, which is perhaps the most sensitive organ.

In a general way, Prof. Irving concludes, one may say that the whole respiratory process in the porpoise is carried on by lungs, blood and heart, which are quite similar to those same systems in a land animal. The porpoise has learned to apply them to a habit of respiration which is rather different and which enables it to swim freely below the surface. In contrast, the human respiratory system does not seem to be organized for this type of work. The difference is, however, one of degree, Prof. Irving points out, and human beings and other land animals frequently hold out for a short interval during which they can go without breathing. The adjustment of their respiration to these short intervals appears to be accomplished in the same manner as in the porpoise, which is, however, more competent at enduring interrupted breathing. Thus, differences and



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similarities between man's respiratory system and that of the porpoise may be studied with the aid of the tanks.

Another type of work made possible is the observation of births in the giant "fish bowl." Just recently scientists were able to study and photograph, for the first time in history, the birth of a porpoise under normal conditions. The baby, perfectly formed, was believed to have drowned when it sank to the bottom of the tank immediately after being born. The mother made frantic efforts to raise the twenty-five pound baby to the surface by balancing it on her snout, but in vain. Staff members at once began assembling all data in an effort to determine the cause of death, hoping to derive information that may help to save other porpoises born in the tanks, information that may throw more light on the entire subject of mammal births.

It is for just such work, as well as for the study of other marine mysteries that a modern laboratory is employed at the Marine Studios. A staff of biologists keeps busy constantly cataloguing newly deciphered knowledge garnered from the lives of the fish. For instance, the known ability of jewfish to change their color so as to blend with their immediate background was demonstrated when a 500-pound jewfish which became blind turned black.

When one of the specimens becomes ill, the staff sets about to determine what medical treatment is necessary. In the case of a baby porpoise, consultations resulted in a decision that a dose of castor oil should be given. After the baby was netted, its mouth was forced open and almost a pint of the oil poured in. After being held a minute or two, to make sure the medicine had been swallowed, the porpoise was released and it swam away, attendants said, with a wry look on its face.

A fishing fleet operated by the studios is in constant search for new specimens for observation and for replacement of species that become extinct in the tanks, either through natural death or violent death caused by predatory enemies. Besides a full stock of nets ranging from four-foot hand nets to 1,000-yard shark nets, this department maintains live-specimen cars, cranes, canvas hammocks and harpoons for handling all kinds and sizes of fish. A spe-

(Continued to page 130A)

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(Continued from page 128A)

cially designed hypodermic harpoon is capable of injecting a drug that in sixty seconds stuns and incapacitates a huge shark for two hours or longer. The staff has perfected a secret invention which will make it possible to capture porpoises and sharks without hooks, harpoon or nets.

What possibilities does this giant "fish bowl" hold for scientific research of the future? First, plans in regard to the porpoise entail the acquiring of information which will ultimately uncover the complete life history of at least one species. Already studies with slow-motion cameras have been launched in attempt to analyze critically the function of various parts of the body in swimming. Then feeding habits of fish will be observed and tests conducted, in the hope that hitherto unknown habits and secrets of fish feedings may be divulged—a subject of tremendous interest to anglers throughout the world.

Dr. G. Kingsley Noble of the American Museum of Natural History, points still further into the future, saying: "Many groups of fishes, such as the giant sharks, start off at certain seasons and unerringly migrate to particular parts of Florida. The problem of what directs the migrations of birds is baffling but the mechanisms which regulate these shark migrations are infinitely more mysterious. A special study may result in an answer to this riddle.

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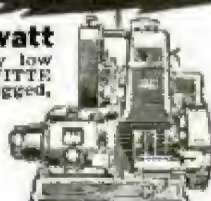
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(Continued from page 171)

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Then he began delving in an unknown
world of speed which exists right under
our noses. He soon solved the mystery of
the flight of birds, photographing purple
finches, homing pigeons, hummingbirds
and tumbling pigeons. Bats, which are fly-
ing mammals, were next investigated and
every detail of their muscular and bony
structures was revealed in actual flight.
Insects were also "stopped" in midair and
the pictures provided more food for
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The tongue of the cat was the subject of
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Sporting-goods manufacturers are vitally interested in his stills showing how concussion affects baseballs, tennis balls, golf balls, footballs, as well as the bats, rackets, clubs and shoes which propel them.

Managers of baseball and football clubs and university athletic directors are poring over his pictures of athletes in action, studying form. Fencing, archery, lacrosse are being taught with the use of his speed-flash photographs.

Surface tensions of liquids and their reaction to force under many circumstances are important to manufacturers and scientists. The formation and life of a drop were revealed in detail. The pear-shape theory of streamlining was muddled by the discovery that a drop flattens out and slips sideways when falling at high speed. It looks more like a corn-flake than a pear.

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Science has long known that quenching molten steels in different liquids produces various effects, depending upon the liquids. Using the ultra high-speed technique, I. N. Zavarine, a scientist, found out why this was true. The bubbles formed by certain liquids tended to insulate the steel and the result was changed.

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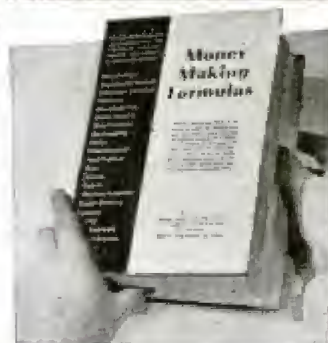
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Minutes That Mean Eternity

(Continued from page 245)

large quantities of soapy water, salt water, or any harmless fluid such as milk, coffee, or soup. But if none of these is handy, give him plain water. Tickling the back of the throat with the finger will help induce vomiting. When this occurs, give more liquids, reinduce vomiting, repeatedly. Meanwhile, have someone send for a doctor.

Suffocation is the inability of the lungs to pump oxygen for the body. Whether caused by hanging, choking, drowning, lightning, electric shock, or the inhalation of noxious fumes, the treatment is always the same—artificial respiration. This should be started immediately, and should



An example of emergency splinting—the broken leg is fastened securely to the uninjured one

be continued until normal breathing is resumed, or until a physician declares it is useless to go on. There are many cases on record where persons have recovered after four hours of continuous treatment; so don't be too ready to give up.

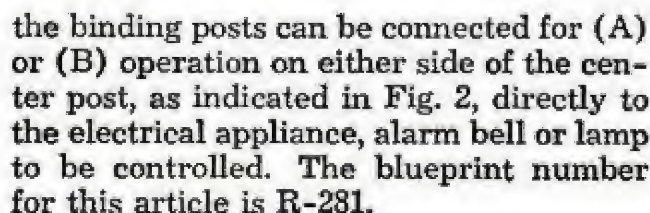
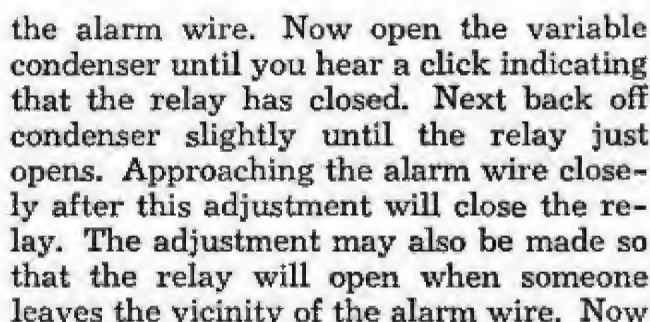
Artificial respiration cannot be learned by reading about it; but it is such an important factor in first aid that everyone should know how to administer it. In practically every community the Red Cross conducts classes in this work, and these classes are open to everyone. Yet every year hundreds die for want of air, while crowds stand by and look on. All because nobody has taken the trouble to learn.

This by no means exhausts the possibilities of first aid. The things described here are those things that need to be done in the great majority of accidents, and need to be done at once—that cannot await the arrival of a doctor. These are the things that save lives in minutes that mean eternity.

Send stamped, addressed envelope to our Bureau of Information for name of maker of any device described in this magazine.

(Continued from page 297)

To test the relay, connect up to 10 ft. of ordinary insulated hook-up wire to act as



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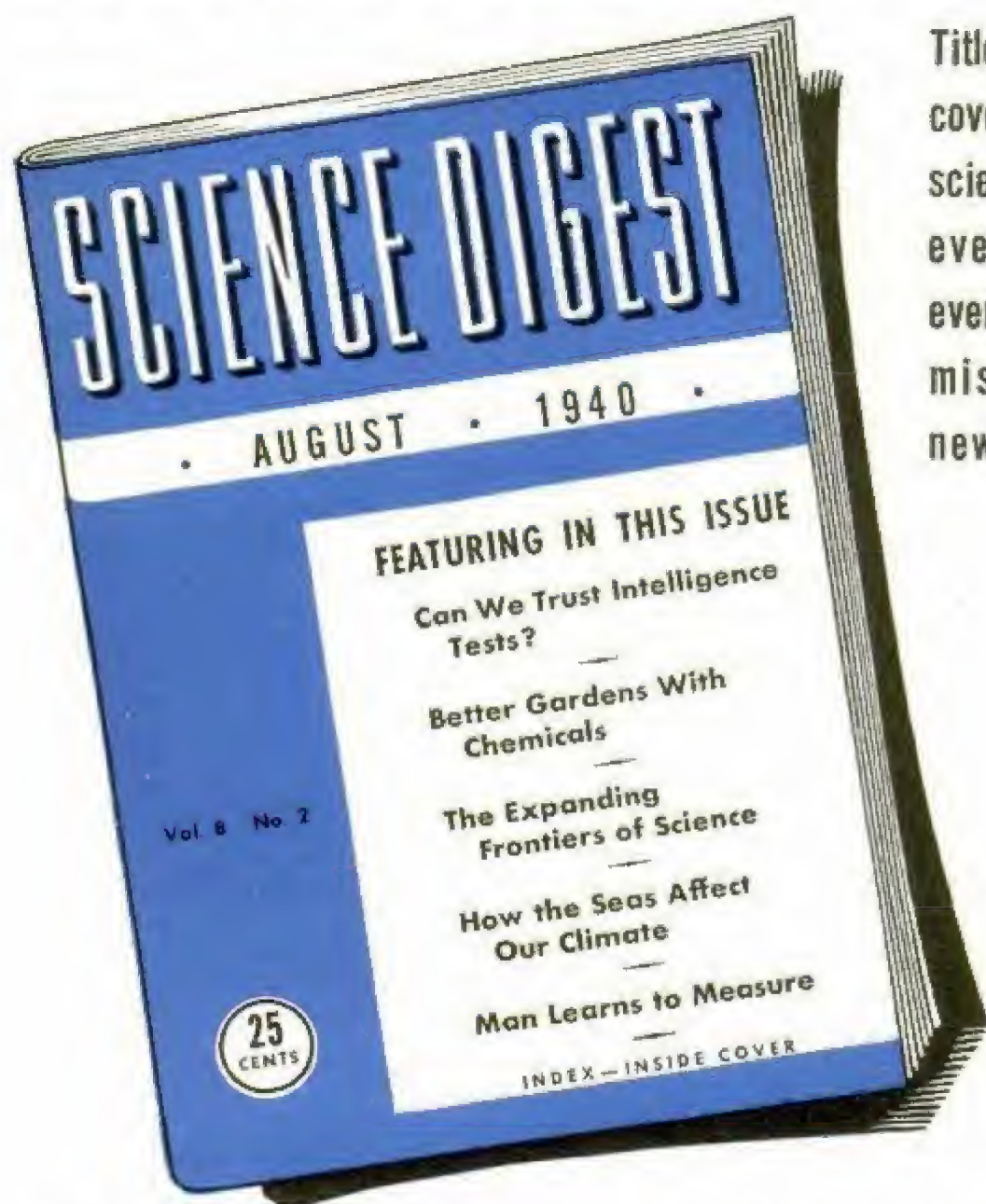
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gardening with chemicals and the effect of the seas upon climate. You have to take climate as you find it but the results of gardening are largely in your hands. A score of easy-to-read digests of scientific articles from all over the world make this August issue of Science Digest one that you will want to read—and keep.

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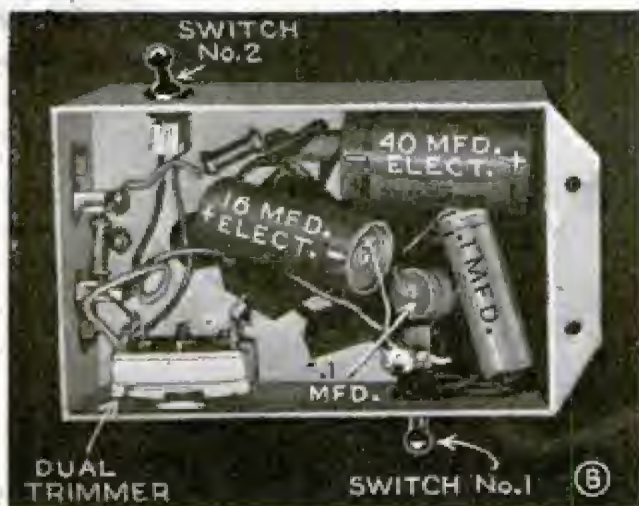
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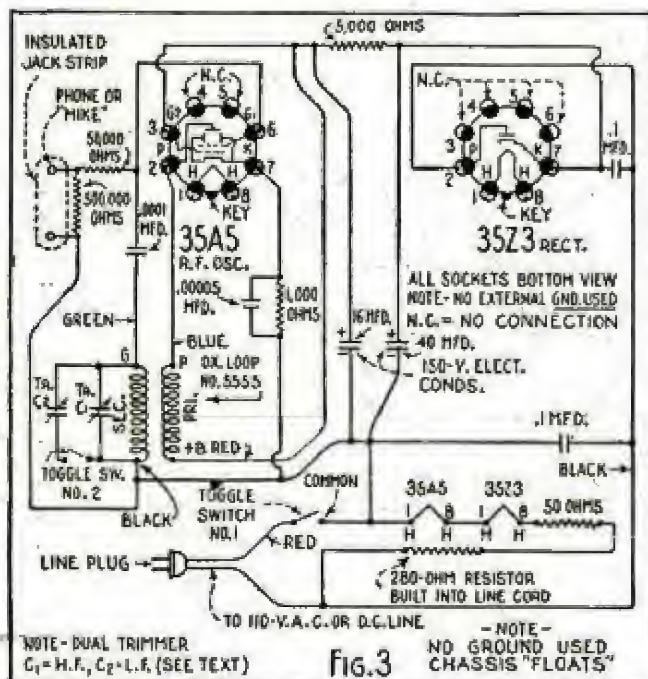
(Continued from page 298)

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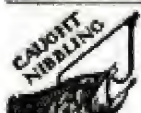
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Super-Speed Roads of Tomorrow

(Continued from page 191)

lane. Beyond, the 100-mile-an-hour lane with large and small passenger cars, trailer-truck-trains of several cars and small farm trucks carrying produce.

A flick of the switch to the "75" dial swings you into the next lane. Another flick and soon your car enters the 100-mile-an-hour section of the transcontinental motorway. Here you stay except for fuel stops.

The wife and children have fallen asleep on their adjustable couch-like seats. You pass Pittsburgh and Fort Wayne without seeing them and at 1:30 a.m. a voice from the box tells you Chicago is forty-seven miles north. You are thankful that highway planning has reduced the jump from 697 miles to 625 by "straight-shot" motorways and has cut the time to nine hours.

Over the Mississippi on a two-mile bridge and into the west until dawn catches up with you in Nebraska. You switch to "75," then "50" and pull into a combination fuel station, emergency stop, restaurant and hotel. After breakfast, the wife takes the wheel and you tilt your seat back for a snooze which lasts until Salt Lake City. Here the fifty-mile lane swings around the lake, but the higher speed roadways draw together and the "100" rises on top of the "75" forming a two-deck bridge. Beyond the lake the climb soon begins in earnest and the lanes no longer parallel each other, each requiring a different grade and curve radius. The "100" and "75" lanes climb a much straighter route than the "50," using cuts, fills, grades and tunnels.

As the altitude signs read "7,000 feet," your tires sing over the now unused snow slots. The road surface is composed of metal with gratings that allow the snow to fall through into receptacles where chemicals melt it. In other sections, a chemical is automatically sprayed over the surface from hydrants which also flush the resultant slush away.

After the short run along "the top of the world," the 75-mile-an-hour route joins up again. Likewise the "50" which has used triple the mileage, but is preferred by sightseeing tourists who have no dinner appointments tonight in San Francisco.

At 4:45 the radio signals the car's approach to a transition point and before

long you dial "75," then "50," soon turning off into the feeder leading to San Francisco.

Jogging along at fifty on a wide express boulevard, a bit tired, but anticipating one of Aunt Lillian's apple pies after the snacks at fuel stops, you wonder why all this wasn't done long ago. Airplanes were making blind landings on radio beams as far back as 1940. Years before that the railroads were operated by automatic signals and controls.

San Francisco, you find, is beginning to look more and more like New York and Chicago as the modern sections crowd out the old. The new blocks are made up of low five-storied structures, every tenth block consisting of one huge skyscraper—a steel and glass shaft set back with garden-terraces. Buildings are restricted to seven different heights. Adjacent to the buildings are recreational and rest facilities. Parks cover one-third of the total land area. Pedestrians and automobiles are kept entirely apart. Shoppers walk on sidewalks at the second-story height of buildings. At intersections, the sidewalks bridge the streets.

The lower motor level is no wider than was the 1940 street together with its sidewalk; but its traffic capacity is double that of 1940. Its traffic lanes extend from building line to building line, not from curb to curb. Cars are parked indoors.

The streets themselves are all one way and of only two widths—100 feet and eighty feet. There are no breaks in the flow of traffic. At intervals of ten blocks each way streets are crossed by a grid of express boulevards, 100 feet wide, designed to ramp alternately above and below the cross streets in a basket-weave pattern, and thus permit an uninterrupted, sustained speed of fifty miles an hour through the heart of the city.

In 1940, street speed in the great city averaged about fifteen miles an hour. Boulevard speed averaged about twenty-five miles. By 1960 both speeds have been exactly doubled.

For which you are mighty thankful, since it is supper time and Aunt Lillian and her delicious apple pies are still three blocks ahead and ten blocks to the right.

You are sorry you loafed at those fuel stops in the mountains, although the scenery was beautiful. Next time you'll hurry.

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Room 840

200 East Ontario St., Chicago

Keeping Midget Racers Rolling

(Continued from page 235)

tios in a few minutes. Most modern midget cars have abandoned the usual clutch and use a positive in-and-out shift. Two wheel brakes, either hydraulic or friction, are satisfactory because of the decelerating effect of the engine when the accelerator is released.

Midget cars average only about sixty-five miles per hour on the quarter-mile tracks yet many enthusiasts would like to see the rules changed so that a midget car could compete against its big brothers in the annual 500-mile Indianapolis race. They think a supercharged midget would have a good chance of placing up among the leaders. A midget has a top speed of about 125 miles per hour as compared to an average top of 175 miles per hour for a big race car, yet one reason why a midget might make a good showing is that the driver probably would be able to drive through turns wide open, the car's lightness and ease of control permitting the driver to make a good average speed around the track. The average midget weighs 850 pounds, half as much as a big car, has up to 100 horsepower as against 200 to 300 horsepower, a tread of forty-five inches as against sixty inches, and a wheel base of seventy inches as against an average for the big cars of 104 inches.

Tuning in the Next President

(Continued from page 223)

a large switching panel standing alongside the speakers' stand and controlled by three technicians. As the chairman of the convention polls a delegation the technicians switch its microphone into circuit and the voice of the delegation's leader is carried into each of the control booths. Any of the networks can cut in or out of the panel, and while the polling continues on the floor, the loud-speaker system alone may be connected with the switchboard, while the networks are bringing in other interesting activity for their listeners.

As the vote is recorded, and its result becomes apparent, the noise of the crowd increases. To enable radio listeners to hear this, technicians switch on the parabolic microphones, which are regular microphone units collared by large curved metal

disks, to permit focusing on distant sounds.

When the band strikes up, a touch of a switch in the control booth brings a close-up of the music by means of microphones in front of the bandstand. If a great demonstration for a favorite son starts, all its exciting sounds are broadcast by a battery-operated short-wave transmitter carried on the back of an announcer on the floor. Its signals are picked up on a short-wave receiving set inside the hall and then broadcast to the nation. The announcer gets his cue by means of a very light short-wave receiver which he also carries.

Televising the Republican convention constituted probably the most elaborate television coverage ever given to a single event. Two mobile television units were used for daily program relays from Philadelphia to NBC's New York City transmitter. Special television camera stands and an interview studio were provided.

The relay from Philadelphia to New York was made over a coaxial cable. Capable of transmitting several hundred telephone messages simultaneously, the cable handled only a single television program.

Blitzkrieg!

(Continued from page 165)

and food. The mechanized units, which can go 200 miles or more a day when unimpeded, carry two days' rations for man and motor. If the first bound carries you through the covering forces and fortifications, the further you go and the faster you move, the easier the going is along that particular line. It is quite possible that, since the roads and resources along those roads are known, fuel and food may be seized. If that be impossible, you must arrange for fast-shuttling motor supply convoys to bring up fuel, ammunition and food daily, while the spearheads of the advance may also be replaced by fresh reinforcing tanks and combat cars which will leapfrog tomorrow the squadrons which started the drive today.

Lest hostile planes take the air from dromes you have not found and bombed, squadrons of pursuit planes cover the advance, to protect both the mechanized units and their following motorized infantry, and also your own attack aviation; that is your anti-aircraft artillery, motor-

(Continued to page 142A)

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ized of course, is rolling with your own columns to furnish additional protection to them and to the bridges and tunnels you have seized.

It all sounds diabolical, fantastic and terrifying. It is. But never has man developed any weapon or technique for harassing his fellowman that antidotes have not been found. The backbone of defense is discipline: training that holds men together in stress, together with a planned organization. Airdrome runways sown with concrete blocks prevent hostile landings. These blocks must be movable, else we hinder our own air power from action, and ground crews must be trained to scatter them and replace them. Runways may be split by traps—counterparts of the draw-bridges of old—to be tripped or replaced at a signal. Highways, too, may be so safeguarded. Bridges must be mined, under the control of men who will, without hesitation, blow them up, when necessary. Waterworks, power plants, telephone and telegraph centrals, radio stations, supply dumps and factories, must be guarded from the "fifth column."

The covering forces—outpost troops—must be trained soldiers. They must be equipped with antiaircraft and antitank guns to cripple and slow down the first rush. Behind them garrisoned where they can be rushed to the place we decide to launch our counterattack, must be the mobile main body, also trained troops. They must be protected by antiaircraft and antitank artillery. Their own spearheads must be mechanized, that they may shoot into the area into which the enemy has swept and in turn disrupt his communications.

Stone-wall defense is impossible, since we cannot be strong in all places at the same time. Once a stone wall is pierced, the path is free for the invader. But our own fortifications must be so arranged that we may use them to protect a flank of the counterattack. Modern war differs from the past only in that we must think in terms of hundred-mile bounds instead of miles, of minutes instead of days. The world has done this in its peacetime traffic systems. It must do it in war.

Our air force must be prepared to leap into action—to harass, to strafe, to get information. This it must do in close coordination with the ground troops and the

navy. Alone, the air force is as useless as a battery of artillery without support. Combined with the other members of the combat team, it becomes a vital force.

Antiaircraft warning systems, by which all the communications resources of the nation will be linked to spread the alarm of approaching aircraft, are essential. Part of this defense net must consist of locally organized bodies of home-defense forces prepared to shoot down the parachutists. The parachute technique is to drop armed men. These reach the ground scattered over comparatively wide space. They must rally into fighting units, must retrieve the machine guns and extra ammunition dropped at the same time. It is not as individuals but as groups that they are dangerous. On the highways, road-building equipment in the hands of trained men may be transformed into road-breaking equipment. Any and every means which will slow down the mechanized forces puts the brakes on blitzkrieg, paves the way for the decisive counterblow. But it cannot be done by theory alone, it cannot be left to untrained individual initiative. It must be planned, it must be organized.

The success of a blitzkrieg is definitely dependent upon ability to follow up the mechanized spearheads with the main body of troops which will organize the ground swept over in the first rush, open the way for unimpeded supply and reinforcement, and mop up the remaining enemy troops. Once the other fellow has time to draw breath, the initiative has been yielded by the attacker. And the essence of it all is time. A counterattack cannot be launched until the direction and extent of the blow be definitely known. One must first parry, get set, then return the blow.

Better still, and certainly less nerve racking, is not only to match the other fellow ship for ship, gun for gun, trained man for trained man, in the air, on the land and on the sea, but also to raise the ante. The pleasant thing about that is that then there probably won't be any blitzkrieg. Or at least the "blitz" won't be on our home folks.

(Note—The foregoing is the opinion and view of an individual, and should not be construed as necessarily reflecting official War Department opinion, nor that of the services in general.)



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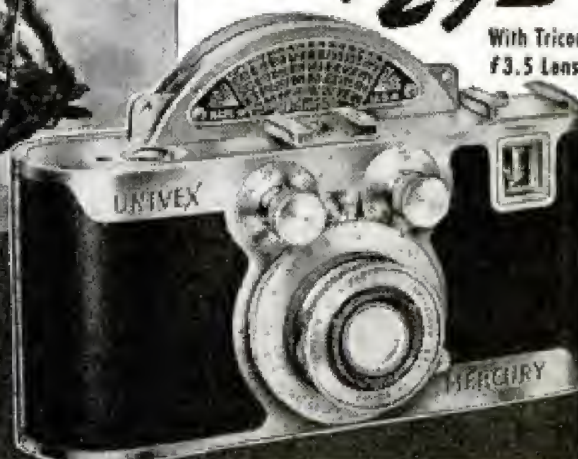
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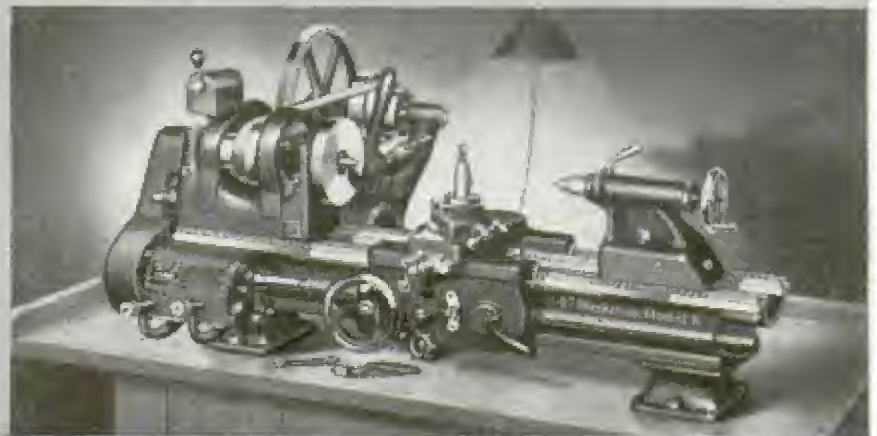
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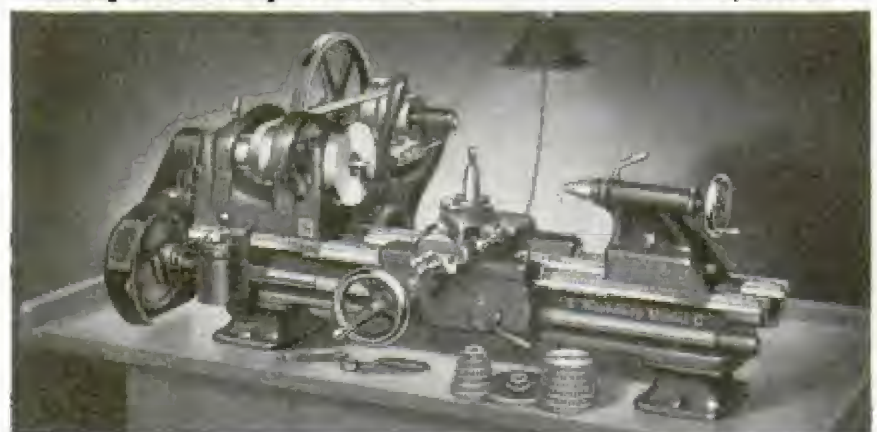
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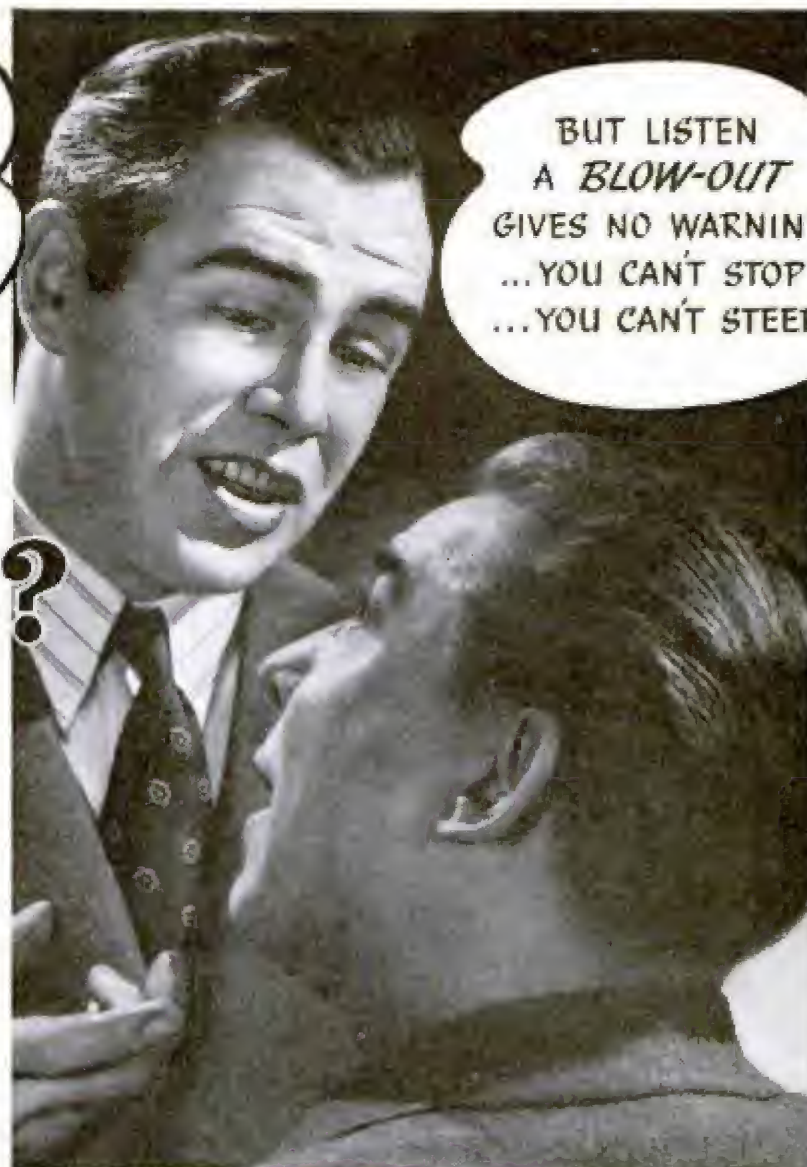
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